The Electrical World.

VOL. XXVI. NEW YORK, NOVEMBER 16, 1895. No. 20.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVI. NEW YORK, NOVEMBER 16, 1895. No. 20.

CONTENTS.

Editorial 537
The Berliner Case 538
The Electric Storage Battery Company in Chicago 538
The Brush Double-Carbon Patent 539
The Siemens-Halske Electric Railway Suit 539
Electricity vs. Steam 540
Rational vs. Empirical Formulas 540
The Conduit System of the Metropolitan Railway Company at Washington, D. C. 541
A Suggestion for a Dynamometer, by Geo. T. Hanchett 542
On an Approximate Linear Relation Between Coercive Force and Maximum Cyclic Intensity in Iron and Steel, by E. J. Houston and A. E. Kennelly 543
Commercial Applications of Electrical Power from Niagara Falls, by W. L. R. Emmet 545
The Invention of the Electromagnetic Telegraph 547
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 548
Electricity in a Shoe Factory 552
A New Push-Button Flush Switch 552
Ironclad Generators and Stationary Motors 552
Electric Rock Drills 553
A Combined Grate and Feed-water Heater 554
DEPARTMENTS:
Financial Intelligence 555
Special Correspondence 555
General News of the Week 557
Trade and Industrial Notes 559
Business Notice 559
Illustrated Record of Electrical Patents 559

THE SAWYER-MAN CASE.

As we go to press the announcement is received that the United States Supreme Court has decided the celebrated McKeesport Sawyer-Man case against the plaintiffs, the Consolidated Electric Light Company, now part of the Westinghouse Electric & Manufacturing Company. As concerns the public at large, the important matter at issue was the claim of the plaintiffs to the fibrous filament, which was contested by the defendants, the General Electric Company, as licensee under the Edison light patents, on two grounds—that Edison was the first inventor, and, if not, that the filament was an old device, which neither of the parties to the suit were entitled to control—the latter, it is understood, being the real defense. Had the plaintiff won the case, it would have possessed the sole right to make fibrous filaments until the expiration of the Sawyer-Man patent, in January, 1897, and as the claim had been set up that the patent covered also the use of "squirted" filaments, it can readily be seen what complications might have ensued in case the decision had gone the other way. In the latter event the plaintiffs would also have established a claim to royalties on the lamps that have been manufactured using the filament in suit, which would probably have resulted in judgments against the General Electric and other companies in very large sums of money.

ARE OUR PENNOCKS NAPPING?

The report that John Jacob Astor is working desperately to obtain control of the Keely motor, should cause a certain element in the electrical field to hang their heads in shame. In view of the wonders that have been accomplished by electricity, though, in the eyes of the world, but yet in its veriest infancy—with a full knowledge of its amazing potency over the modern intellect—and to think of an Astor apparently peculiarly susceptible to the influence of these considerations being left for a mere inventor in etherics to exploit, must indeed be galling to these gentry. Perhaps we are unjust in attributing to ordinary neglect the escape of such a rich quarry, for non-success may be due to the lack of an electrical vocabulary sufficiently rich in cabalistic terms to charm the enervated Crœsian intellect—though from this view the grumblers against the late invasion of units and nomenclature will doubtless decidedly dissent. For, how pitifully vapid is the "volt multiplier and negative pole step-back" in comparison with "the transmission of the etheric flow by means of sympathetic vibration through a harmonious adjustment of the thirds in a rotating circle of etheric force within the twin polar stream of negative attraction"! If the portion of the electrical field to which we refer wishes to escape further humiliation from competitors in etheric, theosophic and other fields, it must be up and doing, and armed with a vocabulary of proposed electrical nomenclature and a glossary of terms from Gilbert's *De Magnete*, be fully prepared when the next Astor appears.

RELATION BETWEEN MAGNETIC COERCIVE FORCE AND INTENSITY.

The paper in another column by Messrs. Houston and Kennelly on an approximate linear relation between coercive force and maximum cyclic intensity of iron and steel, adds another to the interesting contributions to the subject of magnetism recently made by the same authors, and one of direct practical application. While the expression found is merely an empirical one, and does not apply below an intensity of four kilogausses, this does not affect its practical value. In practical work results are the sole object in view, and it

is a matter of indifference if these are arrived at correctly by means of empirical or of rational formulas. As the range within which the formulas give results sufficiently accurate for industrial purposes is well within the working range of iron and steel, the fact that the formulas fail for low magnetizations does not affect their value. It will be noted that the values of the constants differ materially for the various samples of iron and steel for which the data were used, and therefore until further tests have been made of commercial varieties it will be difficult to determine what constants to use in a specific case. On the other hand, since it is shown that a linear relation exists between the coercive force and intensity of magnetization, instead of determining the large number of points required in order to construct the usual curve, it will only be necessary to make two careful measurements in order to obtain constants, by means of which any other value between practical limits may be simply calculated.

THE BUDAPEST CONDUIT RAILWAY SYSTEM AT WASHINGTON.

It is somewhat of a coincidence that the Metropolitan Railway Company, of Washington, should be the second street railway in the United States to adopt the conduit system of electric traction which its New York namesake has found so successful on Lenox Avenue. While the system installed at Washington, a description of which will be found in another column, closely resembles that of Budapest, yet there are a number of differences in detail which, in view of the experience in conduit railway construction of Chief Engineer A. N. Connett, to whom they are due, will most probably render the Washington road an improvement on its European prototype. Aside from the roadbed, the principal differences referred to are in the employment of a T-shaped iron conductor instead of an angle-iron, its attachment to the top instead of side of conduit, and the adoption of a different contact mechanism. The conduit is a concrete trench instead of cast iron, as on the Lenox Avenue road, or riveted sheet iron, as on the Fort Washington line of the Third Avenue Company, where, however, an entirely different electrical system is being installed. The design of the insulated support gives great rigidity to the T-bars, while the method of contact on the opposing vertical faces of the two T-bars is claimed, with apparent reason, to admit of a better design of contact shoe or plow. Portions of the road have been in operation for some time with the most satisfactory results, and there is little or no reason to fear that the system will not stand the test of Winter weather, particularly in a mild climate like that of Washington. This supposed crucial test of the Budapest system is, however, one upon which much stress is laid by street railway managers, particularly with reference to the New York road, and if successfully passed, as experience with the parent European road strongly indicates that it will be, we may look forward next year to somewhat of stampede toward its adoption by cable companies and the building of electric conduit roads on streets in cities which by no chance the trolley would be permitted to invade. One complication may result from such an eventuality, and that is a demand on the part of smaller municipalities for the adoption of the system where the conditions would not justify the greatly increased expense involved in its construction as compared with the overhead trolley. This is a real danger, and it should be strongly impressed upon the public that the conduit system is a possible rival of the trolley only in large cities where a great traffic will justify the very much larger cost of the former.

ROTARY TRANSFORMERS AT NIAGARA.

In this issue we are enabled to print the interesting paper read by Mr. W. L. R. Emmet at the Niagara meeting of the American Institute of Electrical Engineers, on the electrical features of the plants of the Pittsburg Reduction and Carborundum Companies at Niagara. Mr. Emmet's contribution, which was one of the most important made at that meeting, was read from manuscript, and has only appeared in print in the current number of the *Transactions* of the Institute, which accounts for the unfortunate delay in presenting it to the general electrical public. The paper is particularly interesting as indicative of the satisfactory status of modern electrical engineering. But a few years ago the demand for apparatus involving new problems in design generally resulted in extremely crude productions in the first instance, and it was only through a process of rather unscientific evolution that a satisfactory basis of design was finally arrived at. One reason for this is probably that in former days the professional inventor of a firm was also its designer, thus uniting two functions, which in some respects are directly antagonistic; for the tendency of the former would naturally be toward introducing entirely untried features, and departing more or less from established ones. The problem presented to the designers of the rotary transformers at Niagara was one of no small difficulty in view of an almost entire lack of experience in this country with that apparatus. It consisted in producing four machines of over 500 horse-power each, to transform two-phased currents of 115 volts into a direct current of 160 volts; three of these were to be coupled in parallel and have a combined output of 7000 amperes, to be delivered continuously for many hours at a time. The fact that the apparatus when started worked without a hitch, and has been in practical operation now several months without developing any fault, is evidence of how satisfactory a solution was arrived at by the designers. In the discussion at Niagara a criticism offered was that the machines are excessively large for their output, but this, we believe, was satisfactorily met by the explanation that owing to the little exact knowledge obtainable upon some of the points entering into the design, it was thought advisable to use the utmost conservatism. The apparatus for the Carborundum Company is no less novel and interesting. In this case 1000 horse-power was to be delivered, the pressure at the beginning of the process to be 250 volts and gradually reduced to 100 volts at the end. These conditions, involving the regulation of an immense amount of power through a wide range, were satisfactorily met by the design of a sub-transformer having a movable coil, by means of which the mutual induction of the primary and secondary is made variable. While the paper of Mr. Emmet is an admirable one in every respect, it is much to be regretted that fuller details of the rotary transformers and of the regulator were not added—the absence of which, however, is most probably to be ascribed to commercial considerations and not to the author.

The Berliner Case.

In an opinion rendered by Chief Justice Fuller, the Supreme Court of the United States, on Monday decided that it has jurisdiction over the case of United States vs. the Bell Telephone Company to cancel the Berliner patent, which the Court of Appeals for the First Circuit decided against the government. The telephone company moved to dismiss the appeal for the reason that under the Courts of Appeals act the Supreme Court of the United States has no jurisdiction because the case was one "arising under the patent laws of the United States," and judgments of the Courts of Appeals in such cases were made final. The United States opposed this on the ground that the act gave the right of appeal to the United States in cases where it is a party. The result of the decision is that the case will now come before the court at an early date for argument and final action.

The Electric Storage Battery Company in Chicago.

It is reported in Chicago that negotiations are pending for the purchase of the Brandenburgh Corporation and General Electric Railway franchises by Electric Storage Battery interests. The latter company is said to have recently acquired other valuable traction rights of way in Chicago.

The Brush Double-Carbon Patent.

The suit involving the double-carbon arc lamp patent is on the calendar of the present term of the United States Court of Appeals at Chicago. This suit is an appeal on the part of the General Electric Company from the decison of Judge Showalter at Cleveland last May in favor of the Western Electric Company. The patent in suit expires next year, but if the decision of Judge Showalter is reversed, it is said that the General Electric Company will prosecute claims for infringement amounting to $2,000,000.

Electricity in a Paper Mill.

It has been decided by the Cliff Paper Company, of Niagara Falls, to adopt electricity as a motive power, experiments having demonstrated that it is cheaper for the running of their machines. The plant will do away with three steam engines of 200 hp each. The generator will be placed in the gorge below the Falls, and coupled to a horizontal shaft and water-wheel operated under a head of 125 feet. Two motors of 100 hp will be attached to each paper machine.

The Siemens-Halske Electric Railway Suit.

The Metropolitan Elevated Railway Company, of Chicago, last week filed its answer in the suit brought by the Siemens & Halske Electric Company for infringement of electric railway patents. The patent of Ernst Werner Siemens, taken out in August, 1895, is asserted to have been preceded by others years before. A total of 165 patents are quoted by name and date as having priority over the Siemens patent. The answer asserts that the patent was preceded by descriptions published in scientific journals named, and by a paper read before the Society of Arts in London, April 11, 1883, by Alexander Siemens and Edward Hopkinson. Among the long list of American electricians who are named as having preceded Ernst Werner Siemens in the same construction are Edison, Bachelor, Clarke, Green, Field and Finley.

Walter K. Freeman at San Francisco.

Through an incident connected with the never-ending interference proceedings relating to the Gaulard and Gibbs transformer patent case, Walter K. Freeman again posed before the public last week, this time through bribery charges made against a brother and a grand juryman at San Francisco. Freeman is one of the many who claim to have anticipated the subject-matter of the Gaulard and Gibbs patent application, and last week at San Francisco charged that the Westinghouse Company, through its attorney, H. S. Mackaye, attempted by means of threats and bribery to induce Wallace E., Marvin L. and Alexander H. Freeman, three of his brothers, to sign affidavits to the effect that their testimony before the Federal Court at Washington in a previous hearing of the case was perjured in the plaintiff's favor in proceedings before the Federal grand jury.

Marvin L. Freeman deposed that Mackaye had been introduced to him by Warren P. Freeman as William Steele, a San Francisco capitalist, who desired to organize a rubber company backed by Eastern capital. Mackaye, as evidence of good faith, produced a check for $10,000 to be distributed among the four brothers. Before closing the deal, Mackaye informed them that the Westinghouse Company was behind him in the scheme, and, as the testimony of the Freemans had been damaging to that corporation, it would be necessary for them to sign affidavits stating that perjury had been committed by them to secure a verdict for their brother, Walter K. Freeman. Marvin L. further testified that the case had been taken cognizance of by the Federal grand jury, and Warren P. Freeman had approached him with an offer of $10,000 to drop out of the matter or go over to the Westinghouse side. Warren P. Freeman, who has assisted Mackaye throughout, denied that either he or Mackaye had done anything illegal. The "fake" rubber company, he said, was organized as a bait to secure truthful testimony from Wallace E., Marvin L. and Alexander H. Freeman, who, he insisted, had perjured themselves in favor of Walter K. Freeman. The result in these proceedings is not yet known.

Later in the week Judge Morrow sentenced a grand juror named H. J. Summerhayes to six months' imprisonment as the result of further bribery charges in the same case. Walter K. Freeman testified that the grand juror had informed him that he had influence over the jury, and had asked what it would be worth to the Fort Wayne Electric Corporation to have Warren P. Freeman and S. S. Mackaye indicted for intimidating witnesses. Witness said he told Summerhayes that if he was a grand juryman, he did not wish to talk with him, but Summerhayes continued speaking. Freeman's testimony was corroborated by several witnesses, after which Judge Morrow imposed the above sentence.

The Physiology of Death by the Electric Shock.

We have already referred, says the London *Electrical Review*, to the lamentable lack of electrical knowledge displayed by some of the medical correspondents in the *Lancet* in dealing with this interesting question. The letter by Sir George Johnson in last week's *Lancet* is of quite a different order. Sir George Johnson criticises the conclusions of Dr. Bleile in a masterly manner, and appears to have so completely accounted for the results of the post-mortem examinations as to leave little more to be said on the subject. Sir George entirely disagrees with Dr. Bleile's theory that death is due to stoppage of the heart caused by the contraction of the large arteries. He points out that the large arteries are elastic, but have little or no power of contraction under nervous excitement. This power, however, is possessed in a remarkable degree by the small arterioles leading from the large arteries to the capillaries. These arterioles, in fact, act as the stop-cocks to regulate the flow of the blood. But these arterioles do not contract owing to their nerve centres being directly excited by the electric shock, because in this case the arteries would be congested and not empty, as they are always found to be after death by the electric shock. Stoppage of the heart by direct shock is also put out of the question by the fact that one side of the heart is found congested and the other empty. Sir George considers that the condition of the body after death by electric shock corresponds exactly with that found after death by asphyxia. The electric shock paralyzes or destroys the nerve centre which controls the respiratory movements; the passage of venous blood into the arterial system causes contraction of the arterioles, and finally stoppage of the heart exactly as in death by drowning or suffocation. There is therefore always hope of resuscitation, except when the respiratory nerve centre has been destroyed. Sir George's view agrees with that which was put forward some time ago by Dr. A. D'Arsonval. M. D'Arsonval mentions a case in which a workman was stunned by being subjected for a short time to a pressure of 4500 volts. About a quarter of an hour after the accident assistance arrived and artificial respiration was practised. In two hours the man was able to speak, and finally was completely restored. The experiments of Dr. Bleile appeared to be opposed to this theory that death in cases of electric shock is due directly to asphyxia. In none of the cases where dogs were killed in his experiments, was he able to restore animation by artificial respiration, but Sir George Johnson points out that the shocks were large enough to destroy the respiratory nerve centres and place recovery out of the question. The effect of nitrite of amyl, which Dr. Bleile relied so much upon as supporting his view, is known to be similar in cases of asphyxia. The administration of this drug in cases of asphyxia has been found to prolong the action of the heart for a considerable time after it had almost ceased to beat. Its action is to relax the pulmonary arterioles and allow the blood to pass from the right to the left side of the heart. The conclusions of Sir George Johnson on this subject appear to our English contemporary to be authoritative, and it adds that, as it has shown time after time, it may often be the means of saving life to remember the dictum that "a man struck by electricity should be treated as if drowned."

A New Storage Battery Company.

The Reed Electric Company, of Philadelphia, has been chartered, with a capital of $500,000, and has nearly completed a factory for the manufacture of a storage battery invented by Mr. C. J. Reed. The cell, which is of the Planté type, is said to be very light in weight, and, having a large surface and considerable depth of active material, is capable of a high rate of discharge. The cells are formed by a rapid process in forty minutes, it is claimed, while their cost is much less than that of the usual type. The negatives in the portable cells are of zinc, but in the stationary ones are of spongy lead, as usual.

Lord Rayleigh Wins a Prize.

The United States Ambassador at London last week delivered to Lord Rayleigh and Prof. Ramsey a check for $10,000, being the Hodgkin prize awarded by the Smithsonian Institute for their discovery of argon, a constituent of the atmosphere.

Electricity vs. Steam.

In the discussion of a paper read at the Niagara meeting of the American Institute of Electrical Engineers, Dr. Emery gave a brief outline of a case where it was found electricity could not be economically substituted for steam. A large oil company had in its refineries a steam plant using about 80,000 tons of coal a year. There was a large number of pumps for transferring the oil, large and small steam engines, and steam and hydraulic pumps in various buildings, so that steam from about 3000 boiler hp was delivered for power, independent of which more than this amount of boiler power was required for heating purposes. The executive officers had thought of the plan of taking out the steam pumps and putting in power pumps operated by economical engines, and exhaust heating was to some extent used, but as a general system had not received direct attention. Finally, in consultation with the electrical people, they became interested in a large electric transmission system. It was proposed to put a multiphase generating plant of about 3000 kw capacity near one of the boiler stations, where high-pressure steam could be secured, and transmit power electrically through an underground line to multiphase motors in different parts of the buildings and grounds, the lighting being incidentally done by the same plant; the steam for heating, however, to be supplied by the other boilers. The change would cost a considerable sum of money, and Dr. Emery, upon his advice being asked professionally, saw at once it was not a case where a general system of electric transmission was applicable, but advised raising the back pressure on the uneconomical engines, and distributing exhaust steam to the several heating points, meanwhile providing to put in a small multiphase plant of 75 kw to replace three smaller electric lighting plants, and operate a few multiphase motors at different parts of the yard where the steam pipes were very long and much exposed. The results at last accounts, before the work was fully completed, was that two out of the four boiler houses were shut down and coal was being saved at the rate of about 40,000 tons per year. This case is simply an illustration of the fact that electricity is not a "cure-all." It has its desirable features, but sometimes there are other ways by which the results desired can be accomplished much more satisfactorily. The objection to the plan of using large economical units to generate the electrical energy, but running extra boilers to do the heating, was that the heating was so large a portion of the work that by generating steam and running it through the engines first the exhaust steam would develop the power for practically little more cost than the thermal losses in the transmission of steam. In other words, the engine dynamos, the transmission plant and motors should, in order to compete with steam, furnish the power with a quantity of steam sufficiently less than that *condensed* in the steam transmission plant to pay the interest on the investment in the electric plant.

Arcs and Sparks.

Prof. S. P. Thompson, in a Cantor lecture, referred to the fact that many of the earlier experimenters are extremely vague in the way they describe the arc. They do not give definite statements about the actual amount of the current they employed, and one can only judge of the E. M. F. at their disposal by counting the number of cells and trying to find out what sort of cells they had. Modern science gives us the opportunity of being more precise. We can say exactly what E. M. F. we are using, and how much current we are actually sending through an arc. Such arcs as we have in modern practice require an E. M. F. of something more than 20 and something less than 70 volts—varying generally from 40 to 50 in the case where continuous-currents are employed. Under those conditions the arc produced is a very different phenomenon from that which is produced by sending a much smaller current at a much higher pressure ; for then the discharge takes the form of a thin spark. If one sends a spark or a succession of sparks from an induction coil, or from a large influence machine between two brass knobs at a distance from one another in the air, the discharge that one gets resembles the arc, to some extent, but really is a very different phenomenon. The discharge one gets in vacuum-tubes, between terminals of platinum, across the highly attenuated air, is again a different phenomenon. For in neither of those two cases does the material of which the electrodes are formed play any important part in the phenomenon. In these cases, as we now know from the recent researches of Schuster and of J. J. Thomson, there occurs an electrolysis of the gaseous medium. What you produce n these cases is a discharge carried on by gaseous particles, which move about, no doubt, and pass to and fro, and shine, but the light mainly comes from the volatile or gaseous particles and does not come from the solid matter which constitutes the electrodes; whereas, in the true arc itself, the main light comes from the solid matter of the electrodes and not from the gaseous matter of the flame in between. So in the production of the arc a great deal depends—in fact, everything depends—on what that solid matter is. By universal consent, carbon is found to be the only workable material. Moreover, the carbon is consumed at one or both of the electrodes during the continuance of the arc—this circumstance alone constitutes a distinction between the two cases. Now the normal sort of arc produced between two carbon pencils is that which is of industrial value. The others are mere curiosities, so to speak; they may hereafter have an industrial interest, but at present they have only an abstract scientific interest.

Rational vs. Empirical Formulas.

In a discussion at Niagara, Dr. Pupin objected to the introduction into electrical engineering of the methods of mechanical engineers, who are accustomed to represent some of their important physical facts by means of empirical formula, and are satisfied if their formula represent facts with an approximate degree of accuracy. In electrical engineering there is no necessity for empirical formula, at any rate, not in connection with alternating-current curves, and it is not a step forward, but a step backward to substitute an empirical formula in place of an exact formula. Mr. Steinmetz, in the same discussion, said he could see no reason for attempting to represent by empirical formula, phenomena of which a rational equation is in evidence, as is the case with alternating-current and alternating E. M. F. waves. For these a rational formula exists—Fourier's series. All alternating waves, no matter what shape and form they have, have one common feature—that is, they are univalent functions of time, or, in other words, for every value of time, one value only of the function exists. This is self-evident. But as a mathematical conclusion from this feature we derive that all these waves can be expressed by an infinite series of sine functions, and a rapidly convergent series, which, with alternating machine currents, consists of odd terms only, so that all the variously shaped curves can be expressed by very few terms of sine functions.

A Fish Out of Water.

The last century theory that a civil engineer included within his scope the entire range of engineering sciences is still held by a few civil engineers, and with a result that is illustrated by the following correspondence. A civil engineer, whose name is well known in a certain locality, wrote as follows to an electrical firm :

"I am in need of an electrical motor with 30-hp capacity, this same motor to be run with say a 6 or 8 hp engine, 50 feet from motor. Can you furnish such a motor? If so, at what price, and can it be run as I suggest? If you will kindly inquire into this, you will confer a favor."

In reply the inquirer was informed that a motor could not be run from the engine without the intermediary of a dynamo, and further particulars in regard to the case were asked, it being taken for granted that the requirement of "30-hp capacity" contained a typographical error as written. In due time the following reply was received:

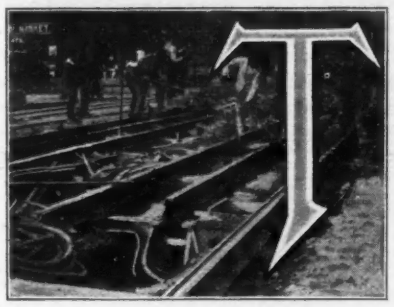
"I of course knew that we would need a generator or dynamo. What I want to know is what price dynamo and motor could be used and at a distance of say 50 feet from a 6-hp engine to develop 30 hp at the motor. You say that owing to the loss in transformation of power we could not realize more than 5 or 7 hp at the motor. This is all the data I can give you at present. I will add a little more. I have 6-hp engine located at 50 feet from the place I wish to develop my power by gearing. Can I use this engine with dynamo and motor to get 30 hp at my gearing—that is, will the horse-power be increased by use of a dynamo? I think I have made this plain."

In answer to this letter the correspondent was informed that the firm addressed did not keep a stock of perpetual motion machines.

A Simple Device to Prevent Evaporation.

A German manufacturer states that if Leclanche cells be filled with a five per cent. solution of sal-ammoniac and five per cent. of glycerine, there will be no evaporation or crystallization of the zinc salts.

The Conduit System of the Metropolitan Railway Company at Washington, D. C.



THE present tendency toward the evolution of a railway system which does not involve overhead construction is looked upon with great interest in large cities, and it is but natural therefore that the Connett conduit system utilized by the Metropolitan Company, of Washington, D. C., should attract a great deal of attention. This system, while at present having its greatest trial to come—in the shape of unfavorable Winter weather—has been installed in such a thorough manner as to indicate great confidence in its ultimate success.

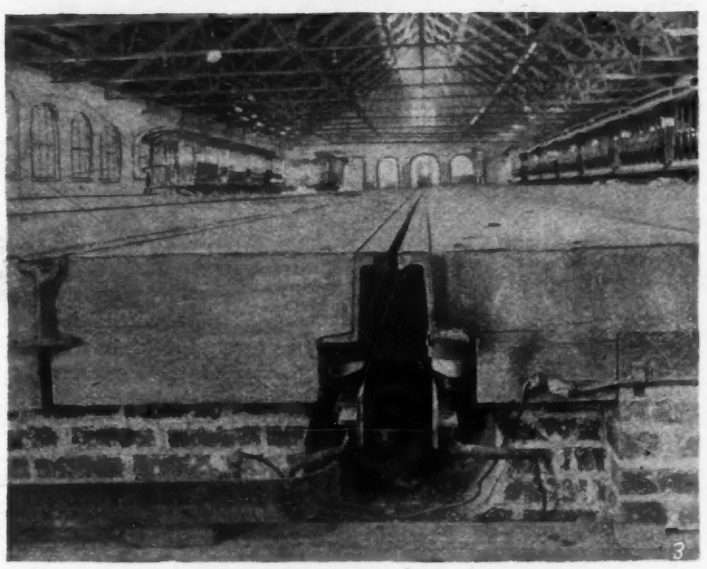


FIG. 1.—OPEN END OF CONDUIT.

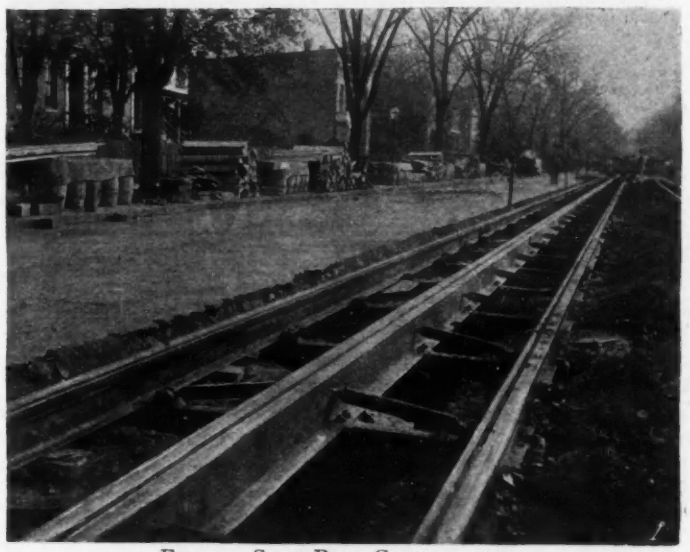


FIG. 2.—SLOT RAIL CONSTRUCTION.

The system was installed under the personal supervision of its designer, Mr. A. N. Connett, the company's engineer. The distinctive constructional features are to be found in the slot rails, the supports, the conductors and the efficient drainage. Cost has been set aside as a secondary consideration. The slot rails weigh 67 pounds to the yard, and are provided with a drip flange which prevents the water from running down the sides of the conduit and reaching the insulators. This is shown in Fig. 1, which gives a view of the end of the conduit in the car barn. The slot rails are braced to the grooved 83-pound car rails by heavy tie rods above each yoke, and are secured at the base to 286-pound cast yokes placed 4½ feet apart. They are bolted in position, and tend to close the slot, but are held back the proper distance by the tie rods before mentioned. The conduit chamber is of concrete packed in around wooden formers which are afterward removed. The supports are of a most substantial character, as will be seen from Fig. 2. The supporting rod is screwed into a porcelain insulator, which in turn is cemented onto an iron cup firmly fastened to the base of the slot rail (see Fig. 3). This supports the live conductor, a heavy iron T-bar weighing 22 pounds to the yard (see Fig. 1), between the faces of which an ingenious contact plow passes, as shown in Fig. 4. The shoe is restrained from vertical play by a pair of levers and a flat spring presses it firmly against the face of the T-bar. A flexible conductor connects the shoe with the leads. The full 500 volts is maintained on the system, and but one half an ampere of leakage has so far been detected. Some trouble was at first experienced from short circuits in the form of iron barrel hoops and other metallic materia which found its way into the conduit, either accidentally or otherwise, but of late that trouble has entirely disappeared.

The drainage of the conduit is ingeniously and thoroughly provided for. A pit 20 inches wide and 6 feet deep is dug every 300 or 400 feet, according to local conditions; this pit extends completely across both tracks, and at one end it is deepened to nine feet and provided with a pipe leading to the sewer at the six-foot level, as shown in Fig. 5. The nine-foot portion serves as a trap basin to arrest

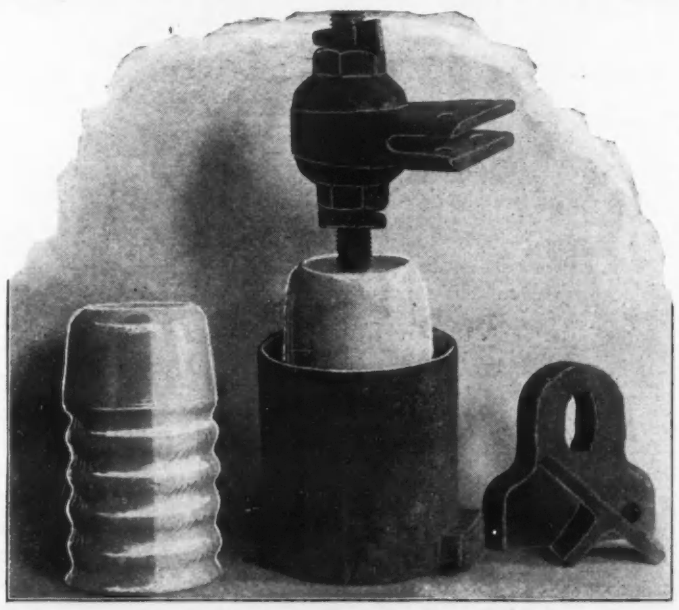


FIG. 3.—DETAILS OF INSULATOR.

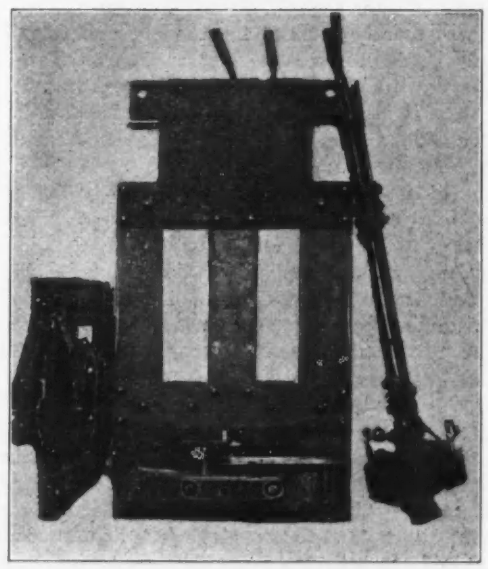


FIG. 4.—THE CONTACT PLOW.

all refuse, which is removed through a manhole provided to give access to the pit and also to the feeder ducts.

The trains consist of a motor car and trailer and can readily make 20 miles an hour over the excellent track construction. The station contains three 400-hp units, exactly alike in all respects, each comprising a Greene tandem-compound engine direct-connected to a General Electric multipolar generator. The armatures are of the extended head, drum type, but their ease of repair amply compensates for the extra room that they occupy. The engines have a four-foot stroke and run at 98 revolutions a minute. Their average load is at present 168 hp, but despite the fact that this is less than half load, a coal economy is reported of 3.66 pounds per electrical horse-power-hour measured at the switchboard. This does not allow for the coal used by a small lighting plant for the carbons and that used by the feed and air pumps. An elaborate switchboard is provided,

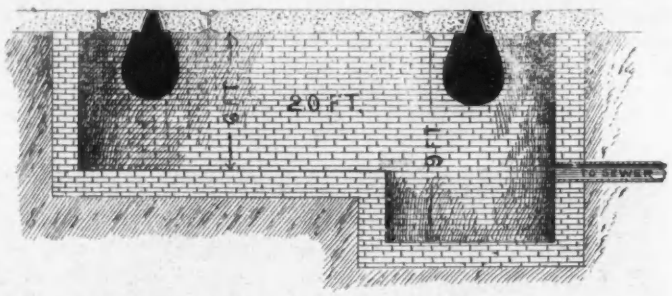


FIG. 5.—DRAINAGE PIT.

equipped with all the usual instruments, together with a Weston ground detector and a recording wattmeter sufficient in capacity for the full station load. The engines are supplied with steam at a gauge pressure of 120 pounds by three Campbell-Zell water-tube boilers of a capacity of 250 hp each. Two of the boilers are banked into a battery.

The power station is rather disadvantageously located at the extreme end of the four-mile double track. Notwithstanding this difficulty, the maximum drop is but 20 volts, which indicates the existence of an excellent feeder system. Both power house and car barn are not only well suited to their purpose, but are fine architectural productions.

A Psychological View of Street Lighting.

In a leader on street lighting our London contemporary, the *Electrician*, asks: "What is the goal to be aimed at? At one time," it says, "many were led astray by that Will-o'-the-wisp—uniform illumination. To give a street uniform illumination is not indeed beyond the resources of science, but it is decidedly beyond the resources of ratepayers, unless, of course, the lighting is to be uniformly poor. Then, again, others appear to have contented themselves with merely intensifying the old 'pilot-light' system; the boundaries between pavements and carriageways are defined by lines of lamps, and distribution is neglected altogether. At one end of the scale there is an unattainable ideal—if ideal it be, which is extremely doubtful—at the other end a disgraceful ideal. Is there no happy mean," it inquires, "and if there is, is it worth a little trouble and study and experiment to attain?" The writer then relates that one evening last Summer he took an evening stroll and soon found himself stepping from the dimly lighted, though by no means religiously gas-lighted side streets, into a broad main thoroughfare illuminated by fourteen ampere arcs under large ground-glass globes. "The contrast between the two methods was most striking. Having nothing more pressing to do, we amused ourselves by trying to analyze our sensations. Why was there such a warmth and such an exhilarating effect? The outcome of our cogitations was that our pleasurable feelings were not due to a good dinner, for we had not dined, nor to a fat balance at the bank, but to the beautifully adjusted luminous maxima and minima—the former not too painfully brilliant, the latter not too painfully dark—and to the existence of an appreciable amount of diffused light." It is declared satisfactory, therefore, to learn on M. Blondel's authority that "the public is indifferent as to the uniformity of illumination. They wish to have a street not only moderately well lighted as a whole, but also to have some places more brilliantly illuminated." The writer adds, however, that the scientific consideration of the general problem is somewhat too abstruse for that much over-tasked biped, the borough surveyor—perhaps for the reason that psychology forms no part of his acquirements.

A Suggestion for a Dynamometer.

BY GEORGE T. HANCHETT.

Very often in laboratory practice a good dynamometer that does not destroy the power is very desirable. The following is a description of one that is cheap and as accurate as any of its class. The necessary materials are some heavy timbers—heavy in proportion to the machines to be tested—a little hardware and a platform scale, or, with smaller appliances, a spring balance. A diagram of the device is shown in Fig. 1. A platform is suspended by beams that are

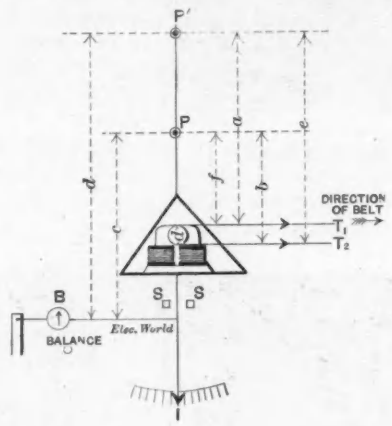


FIG. 1.

pivoted, and the point of suspension may be either P_1 or P. A scale is provided to indicate when the device is vertical, and stops S, S, are placed so as to limit the motion of the apparatus. The dynamo or other device is placed on the platform, with its shaft in line with the side supports, and both upper and lower side of belt exactly horizontal. It is well to have the diameter of the driving pulley as large as convenient. The pull of the belts is balanced by the action of the balance B. The operation is as follows: The machine is started and when all is ready the balance is tightened until the index I shows the apparatus to be vertical. The balance is then read. This is with the pivot at P_1. Then the pivot is changed to P and a second reading is taken. Let these two readings be ω and ω_1 respectively.

Then taking moments about P_1 and P

$$\omega d = T_1 a + T_2 e$$
$$\omega_1 c = T_1 f + T_2 b$$

where T_1 and T_2 represent belt tensions.

Solving,

$$T_1 = \frac{\omega d b - \omega_1 c e}{a b - f e}$$

similarly,

$$T_2 = \frac{\omega_1 c a - \omega d f}{a b - f e.}$$

$$T_1 - T_2 = \frac{\omega d b - \omega_1 c e - \omega_1 c a + \omega d f}{a b - f e}$$

$$= \frac{\omega (d b + d f) - \omega_1 (c a \times c e)}{a b - f e.}$$

With any one pulley and position all small reference letters may be replaced by calculated constants.

$$T_1 - T_2 = WK - W_1 C$$

$$\text{Ft. lbs. per min.} = (W_0 K - W_1 C) S$$

where S=speed of belt in feet per min.

Electrical Equivalent of an Avalanche.

When one is told that, according to the calculations of Dr. Preller, the total expenditure of energy in the avalanche which occurred Sept. 11 near the famous Gemmi Pass, in the Alps, was 4,400,000,000 meter-tons, it gives one but a vague and indefinite idea. In such huge figures a few ciphers, more or less, have little influence on the mind, but by reducing to everyday quantities, such as we have to deal with, and pay for in our meters, a better idea of the significance of the statement may be obtained. The above amount of energy, which was expended in one minute is equivalent to an activity of 1,000,000 hp, and sufficient, at the rate of ten 15-cp lamps per hp, to run about 90,000 lamps five hours per day for one whole year.

On an Approximate Linear Relation Between Coercive Force and Maximum Cyclic Intensity in Iron and Steel.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

In THE ELECTRICAL WORLD for June 1, 1895, Vol. XXV., No. 22, page 631, and for Aug. 24, 1895, Vol. XXVI., No. 8, page 212, we have shown that according to the measurements of Ewing, Ewing-Klaassen and Fessenden, an approximately linear relation exists between remanance and maximum cyclic intensity in iron and steel, between the intensities of 500 and 9000 gausses, and in some cases up to 16,000 gausses.

Since the publication of the above we have discovered that an approximately linear relation also appears to exist between coercive force and maximum cyclic intensity above 4000 gausses. This approximate or empirical relation has at least been deduced from an

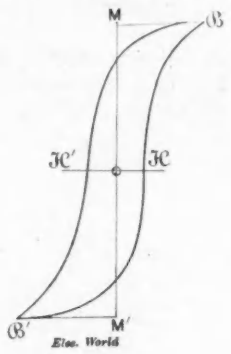


FIG. 1.

analysis of the observations of Ewing and Klaassen published in their paper read before the Royal Society, June 15, 1893, Phil. Trans., Vol. 184 A., pp. 985–1039.

The observed cyclic values of maximum intensity and coercive force are recorded by the observers in that paper in tabular form. We have plotted these results in the curves of the accompanying figures with ordinates to a scale of coercive force and abscissæ to a scale of maximum cyclic intensity.

Fig. 1, represents a magnetic cycle in iron, the magnetizing force being measured along the axis *O H*, in gilberts per centimetre, and the intensity of the magnetic flux measured along the axis *O M*, in gausses. Since in the descending branch *B H'* B', it is necessary to apply a demagnetizing force *O H'*, in order to reduce the intensity to zero, or demagnetize the iron, *O H'* is, in gausses, or gilberts per centimetre, the coercive force of the iron. If the iron be very hard, *O H' = O H*, will be large, while if the iron be very soft, *O H' = O H* will be small. We propose to show that from the Ewing-Klaassen measurements above referred to, an approximately linear relation exists between *O M* and *O H*, or between *O M'* and *O H'*, when *O M* exceeds 4000 gausses.

The tests are recorded, in the Ewing-Klaassen paper above referred to, of eight sample rings of iron tested by the ballistic method in varying cycles. These rings are numbered I, II, III–VIII. The observations for Ring No. I are recorded on pages 992–996 with the following results:

Observed: Maximum Cyclic Intensity. Gausses.	Observed: Coercive Force. Gilberts per cm.	Calculated: Coercive Force. Gilberts per cm.	Calculated: Difference.
16,640	4.75	4.80	−0.05
14,810	4.55	4.49	+0.06
12,940	4.20	4.18	+0.02
10,870	3.84	3.84	0.00
8,840	3.59	3.51	+0.08
6,780	3.20	3.17	+0.03
5,260	2.88	2.92	−0.04
3,280	2.25	2.59	−0.34
1,410	1.46	2.28	−0.82
270	0.36	2.10	−1.74

Plotting these values as in Curve I, of the accompanying Fig. 2, we observe that for values of $\mathfrak{B}$ above 4000 gausses, the observations fall practically upon the straight line.

Coercive $\mathfrak{H} = 2.05 + 0.000165\ \mathfrak{B}$ gilberts per centimetre.

Since, in very small cycles, the coercive force must almost vanish, whereas by this formula the coercive force for vanishing $\mathfrak{B}$ would be 2.05 gilberts per centimetre, it is evident that the law cannot hold for small cycles, and reference to the figure shows that it commences to apply at intensities of 4000 gausses.

Ring II, made of fine steel wire, has its results tabulated on pages 995–997, as follows:

Observed: Maximum Cyclic Intensity. Gausses.	Observed: Coercive Force. Gilberts, per cm.	Calculated: Coercive Force.	Calculated: Difference.
17,680	7.71	7.87	−0.16
16,720	7.43	7.63	−0.20
15,040	7.06	7.21	−0.15
12,070	6.48	6.47	+0.01
10,190	6.00	6.00	0.00
8,090	5.61	5.47	+0.14
6,170	5.01	4.99	+0.02
3,960	4.28	4.44	−0.16
1,820	2.83	3.91	−1.08
1,180	1.94	3.75	−1.81
320	0.45	3.53	−3.08

Plotting these values, as before, in Curve II of the accompanying Fig. 2, it is seen that beyond 4000 gausses of maximum intensity the observations conform fairly well, although not perfectly, with the straight line.

Coercive $\mathfrak{H} = 3.45 + 0.00025\ \mathfrak{B}$ gilberts per cm.

It will be observed that the discrepancy between the corrected and observed coercive forces is very small above 4,000 gausses, but very large below that value.

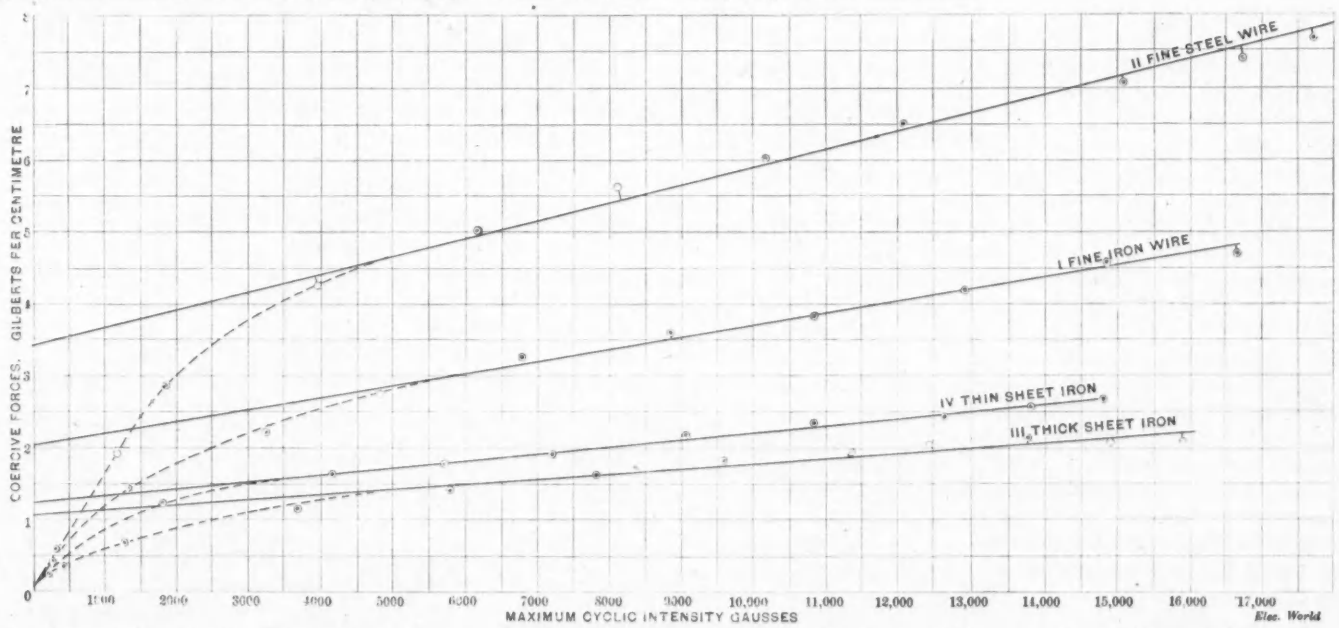


FIG. 2.—CURVES INDICATING APPROXIMATE LINEAR RELATION BETWEEN COERCIVE FORCE AND MAXIMUM CYCLIC INTENSITY IN IRON AND STEEL. EWING AND KLAASSEN, 1893.

Ring III made of thick sheet iron has its results tabulated on page 1000, as follows:

Observed. Maximum Cyclic Intensities. Gausses.	Observed. Coercive Force. Gilberts per cm.	Calculated. Coercive Force. Gilberts per cm.	Calculated. Difference.
15,920	2.10	2.11	−0.01
14,920	2.12	2.09	+0.01
13,730	2.10	2.01	−0.09
12,460	2.01	1.92	−0.09
11,340	1.96	1.84	−0.12
9,520	1.79	1.72	−0.07
7,790	1.61	1.60	+0.01
5,830	1.44	1.46	−0.02
3,720	1.20	1.31	−0.11
1,360	0.69	1.15	−0.46
400	0.28	1.08	−0.80
170	0.12	1.06	−0.94

Plotting these results in Curve III of Fig. 2, we find that beyond 4000 gausses, the linear relation is fairly well observed.

Coercive $\mathfrak{H} = 1.05 + 0.00007\ \mathfrak{B}$ gilberts per centimetre.

It will be noticed that magnetically this iron was very soft, since both the constant term 1.05, and the coefficient 0.00007 are small, compared with theirvalues in the cases of Rings I and II.

The results for Ring No. IV of thin sheet iron are tabulated on page 1002, as follows:

Observed		Calculated	
Maximum Cyclic Intensity. Gausses.	Coercive Force. Gilberts per cm.	Coercive Force. Gilberts per cm.	Difference.
14,720	2.66	2.67	—0.01
13,760	2.56	2.58	—0.02
12,640	2.46	2.46	0.00
10,880	2.31	2.29	+0.02
9,030	2.12	2.10	+0.02
7,250	1.94	1.93	+0.01
5,710	1.79	1.77	+0.02
4,160	1.62	1.62	0.00
1,800	1.20	1.38	—0 18

Plotting these results in Curve IV of Fig. 2, it is seen that they closely conform above 3000 gausses with the straight line.

Coercive $\mathfrak{H} = 1.2 + 0.0001\ \mathfrak{B}$ gilberts per centimetre.

Ring No. V of soft thin sheet iron, has its results stated on page 1005, as follows:

Observed		Calculated	
Maximum Cyclic Intensity. Gausses.	Coercive Force. Gilberts per cm.	Coercive Force. Gilberts per cm.	Difference.
12,366	1.92	1.93	—0.01
11,300	1.87	1.87	0.00
10,120	1.80	1.78	+0.02
8,940	1.71	1.68	+0.03
7,530	1.62	1.53	+0.09
6,100	1.47	1.50	—0 03
4,730	1.42	1.40	+0.02
3,240	1.02	1.28	—0.26
1,210	0.68	1.15	—0.47
220	0.10	1.08	—0.98

Plotting these in Curve V of Fig. 3, which is drawn separately from Fig. 2, in order to avoid the complexity arising from too great a number of lines on a single diagram, it will be observed that the observations above 4,000 gausses fall closely upon the straight line.

Coercive $\mathfrak{H} = 1.07 + 0.00007\ \mathfrak{B}$ gilberts per centimetre.

The results of Ring No. VI, composed of fine ironwire. are stated on page 1,006, as follows :

Observed		Calculated	
Maximum Cyclic Intensity. Gausses.	Coercive Force. Gilberts per cm.	Coercive Force. Gilberts per cm.	Difference.
11,330	4.83	4.88	—0.05
9,430	4.52	4.51	+0.01
7,730	4.20	4.17	+0.03
6,230	3.86	3.87	—0.01
4,220	3.43	3.46	—0.03
1,290	1.65	2.88	—1.23

Plotting these observations on Curve VI, of Fig. 3, it will be observed that above 4000 gausses they fall very close to the line.

Coercive $\mathfrak{H} = 2.62 + 0.0002\ \mathfrak{B}$ gilberts per centimetre.

The results for Ring No. VII, of cotton-covered iron wire, are collected on page 1008, as follows :

Observed		Calculated	
Maximum Cyclic Intensity. Gausses.	Coercive Force. Gilberts per cm.	Coercive Force. Gilberts per cm.	Difference.
15,980	2.81	2.85	—0.04
14,340	2.74	2.73	+0.01
12,860	2.61	2.61	0.00
11,420	2.52	2.51	+0.01
10,090	2.41	2.41	0.00
8,520	2.22	2.29	—0.07
5,780	1.84	2.08	—0.24
2,260	1.17	1.82	—0.65
390	0.32	1.68	—1.36

Plotting these curves of Fig. 3, we find that the observations conform fairly well above 5000 gausses with the straight line.

Coercive $\mathfrak{H} = 1.65 + 0.000075\ \mathfrak{B}$ gilberts per centimetre.

The results for Ring No. VIII, made of soft iron wire, are tabulated on page 1010, as follows.

Observed		Calculated	
Maximum Cyclic Intensity Gausses.	Coercive Force. Gilberts.	Coercive Force. Gilberts.	Difference.
15,600	2.95	3.0	—0.05
14,200	2.89	2.87	+0.02
13,020	2.85	2.77	+0.08
11,690	2.71	2.66	+0.05
10,160	2 61	2.53	+0.08
8,490	2.40	2.40	0.00
5,950	2.17	2.19	—0.02
2,490	1.47	1.90	—0.43
900	0 60	1.77	—1.17

Plotting these results, we find that they nearly conform to the Curve VIII, Fig. 3, with the straight line.

Coercive $\mathfrak{H} = 1.7 + 0.000082\ \mathfrak{B}$ gilberts per centimetre.

After reannealing the iron in this ring it was tested again with the following results recorded on page 1012, as follows :

Observed		Calculated	
Maximum Cyclic Intensity. Gausses.	Coercive Force. Gilberts per cm.	Coercive Force. Gilberts per cm.	Difference.
16,170	2.98	3.05	—0 07
15,490	2.95	2.99	—0.04
14,870	2.89	2.94	—0.05
13,840	2.85	2.85	
12,640	2.73	2.74	—0.01
10,940	2.56	2.59	—0.03
8,640	2.44	2.38	+0.06
4,000	1.71	1.96	—0.25
1,390	1.00	1.73	—0.73
660	0.70	1.66	—0.96

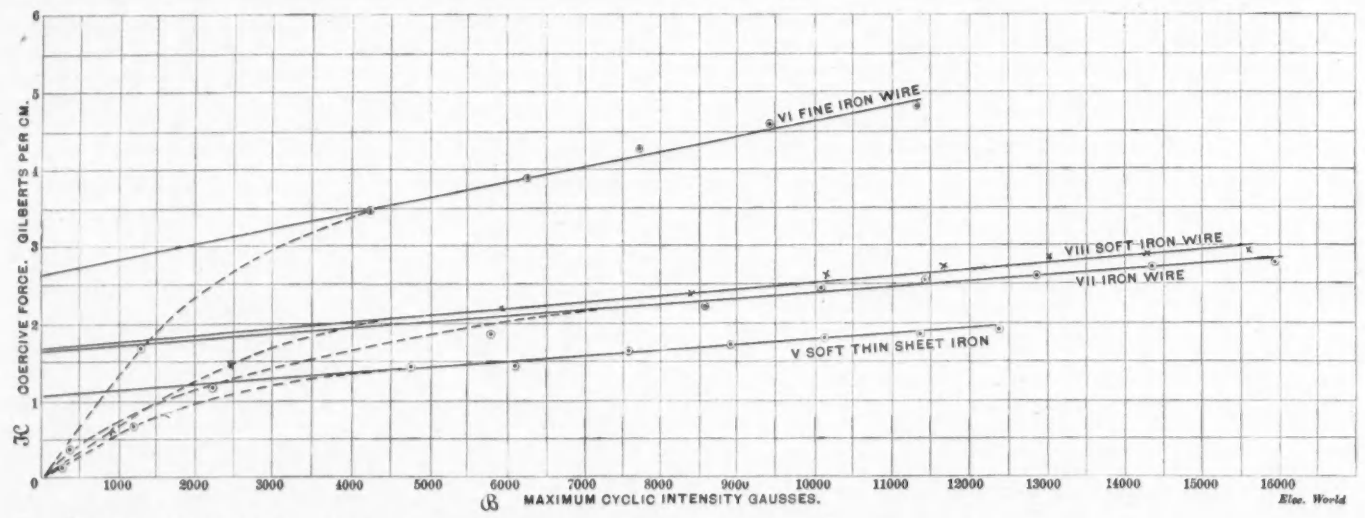


Fig. 3.—Curves Indicating Approximate Linear Relation Between Coercive Force and Maximum Cyclic Intensity in Iron and Steel Above Four Kilogausses, From Observations by Ewing and Klaassen.

On completing these results, there are found above 4000 gausses to conform closely to the straight line.

Coercive $\mathfrak{H} = 1.6 + 0.00009\ \mathfrak{B}$ gilberts per centimetre.

Collecting these results tabularly, we have for the various samples of iron, tested by Ewing and Klaassen, the coercive force :

Fine iron wire, Ring No. I,	beyond 4000	gausses	$2.05 + 0.000165\ \mathfrak{B}$
Fine steel wire, Ring No. II,	"	"	$3.45 + 0.00025\ \mathfrak{B}$
Thick sheet iron, Ring No. III,	"	"	$1.05 + 0.00007\ \mathfrak{B}$
Thin sheet iron, Ring No. IV,	3000	"	$1.2 + 0.0001\ \mathfrak{B}$
Soft thin sheet iron, Ring No. V,	4000	"	$1.07 + 0.00007\ \mathfrak{B}$
Fine iron wire, Ring No. VI,	"	"	$2.62 + 0.0002\ \mathfrak{B}$
Iron wire, Ring No. VII,	5000	"	$1.65 + 0.000075\ \mathfrak{B}$
Soft iron wire, Ring No. VIIIa,	4000	"	$1.7 + 0.000082\ \mathfrak{B}$
Soft iron wire, Ring No. VIIIb,	"	"	$1.6 + 0.00009\ \mathfrak{B}$

It may be pointed out that although in the cycles here considered the linear relation is fairly well maintained between four and sixteen kilogausses, yet the law can only be regarded as an empirical one,

which may be usefully employed, however, in calculations dealing with the magnetic circuit. The actual curves are not straight lines, but appear to be asymptotes to straight lines.

Since we have already pointed out that an approximate linear relation exists between remanance and maximum cyclic intensity, and since the results here quoted point to an approximate linear relation between coercive force and maximum cyclic intensity, it would appear to follow that, within certain limits, an approximate linear relation exists between remanance and coercive force in cyclic magnetization of iron and steel.

Laboratory of Houston and Kennelly, Philadelphia.

Commercial Applications of Electrical Power from Niagara Falls.*

BY W. L. R. EMMET.

The first arrangements which were made by the Niagara Falls Power Company for the commercial application of the electric power of Niagara Falls were with the Pittsburg Reduction Company for the delivery of direct current for the manufacture of aluminium by their electrical process. In this process the cost of power is an important factor, and it is therefore naturally one of the first industries which we would expect to find attracted by the great advantage offered by this town. The contract made with this company requires the continuous delivery of 1500 electrical hp in direct current at 160 volts. The aluminium process is a continuous one, and cannot be interrupted without serious loss, since the product is not perfect while the furnaces are being started, or when they are not in their normal working condition. It is therefore necessary that spare apparatus be always held in reserve, so that in case of accident the proper working conditions cannot be seriously interrupted. To fill these requirements the Cataract Construction Company has ordered from the General Electric Company the apparatus which is now installed in the Reduction Company's building.

This apparatus consists of four rotary converters, having capacity of 400 kw each, and eight transformers, each with a capacity of 200 kw. The rotary converters are intended to be used three at once in parallel, the fourth being always in reserve. These machines transform two-phase currents at 115 volts into direct current at 160 volts, the output of the three being 7000 amperes, which will be delivered continuously.

The stationary transformers are designed for a primary voltage of 1000 and a secondary voltage of 115, their function being to reduce the current generated in the main power station to a suitable pressure for conversion into the desired direct current. In addition to the rotary converters and transformers, the General Electric Company has furnished switchboards, conductors, cooling apparatus, cables to connect the plant to the generating station and all the necessary accessories.

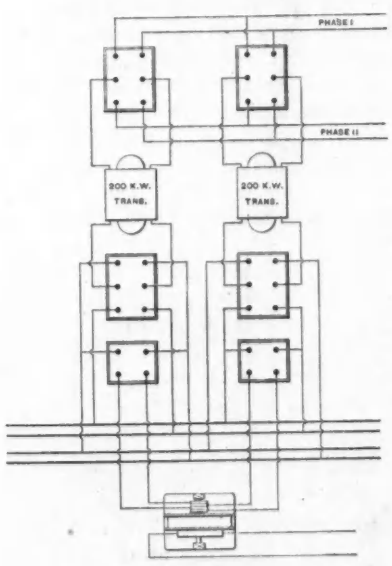


FIG. 1.—DISTRIBUTING SWITCHBOARD CONNECTIONS, PITTSBURG REDUCTION COMPANY.

The rotary converters installed are of 20 poles, and are operated at 150 revolutions per minute, giving a frequency of 25 cycles per second. The armature is of the smooth body type, having a cylindrical winding of conductors formed of pressed stranded cables. These cables are made up of small bare copper wires loosely twisted into a strand. This strand is then placed in a die under a powerful press and is pressed into a rectangular form, the wires being so pressed together that the cable has practically the same effective copper section as a solid bar of the same size. In spite of this pressing together of the wires, we find, by experiments, that parasitic currents are practically eliminated by this form of construction. On each side of the laminations of the armature there are cylindrical extensions for the crossings of the armature conductors. The whole winding is on a cylindrical surface, the ends of the stranded cables themselves being jointed together at the outer edges of the extensions. This machine has a small armature reaction, 5500 ampere-turns per pole, and has an average potential difference between commutator bars of 3.6 volts. Copper gauze brushes are used, there being 20 studs with three brush-holders per stud. The brushes are shifted and raised from the commutator all at once by hand-wheels. The field frame of the machine is cast iron, and the magnet cores and pole-pieces are of cast steel. The cores are made in spool form, there being an enlargement at one end to form the pole-pieces, and at the other to increase the area of contact with the cast iron. The base is in a single casting with the pillow blocks, giving rigidity and alignment. The commercial efficiency of these machines is about 94 per cent.

The stationary transformers used in the plant are of 200-kw capacity each, eight being used in all. They are kept from injurious heating by currents of air delivered from below, which pass upward through the body of the transformer and over the surface of the coils. Both the laminations and the coils are built for the circulation

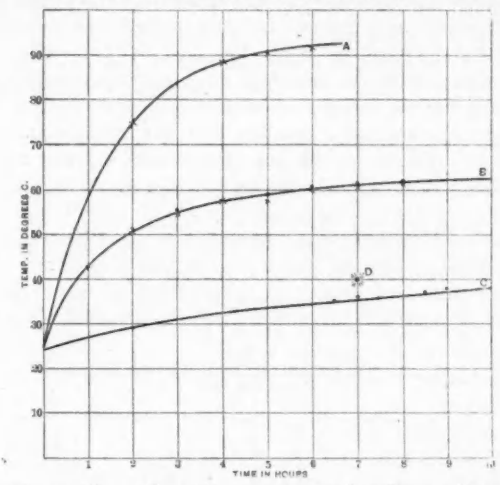


FIG. 2.—HEAT TEST CURVES OF 200-KW AIR-BLAST TRANSFORMER.

of air, and the space pieces in the iron are so arranged that the air will follow the paths where it will do most good. The transformers are placed in the room without casing or covering, so that much of the heat is carried away by radiation and by convection of the outside air. The construction of these transformers will be clearly understood when they are examined as they stand in the Pittsburg Reduction Company's building. The laminations are held between two cast iron frames by bolts and side frames, which hold the whole structure rigidly together. The weight of the laminations is borne by two pieces of "I" beam held between the end frames on which the edge of the punchings rest. These "I" beams also serve to form a compartment under the transformer, into which the circulating air is delivered. There are four primary and five secondary coils in the transformer, alternately placed with air spaces between them. This arrangement gives ample cooling surface and freedom from magnetic leakage. The accompanying curve shows the temperature of one of these transformers when run at full load, with an air blast of 1040 cubic feet per minute, requiring a power of about one quarter of one per cent. of the transformer. The temperatures here given are taken by resistance measurement of the coils. It will be observed that the effect of the air-blast is very great the maximum temperature being practically reached in three hours. The curve also shows that if the air-blast was stopped when operating under normal conditions, about three hours would elapse before a dangerous temperature was reached. In Fig. 2, curve *A* represents temperatures without blast, curve *B* temperatures with a blast of 1040 feet per minute, and curve *C* temperatures of air issuing from the transformer. Point *D* is the temperature of the laminations after seven hours of air-blast at 1040 cubic feet per minute.

The air for cooling transformers is conveyed to them through a large duct or covered trench above which they are placed. This space is formed by an excavation in the floor, with brick retaining walls, and is covered by iron plates flush with the floor, all being made practically air tight. The plates on which the transformers stand are provided with openings in the form of grids with slide valves, by which the admission of air to the transformer can be regulated at will or shut off altogether. The air is supplied by a 60-inch Sturtevant blower, directly coupled to a 5-hp motor. Two of these are installed, one as a reserve. Either will give sufficient air to cool 3000 hp in transformers.

*A paper read at the Niagara Falls meeting of the American Institute of Electrical Engineers.

The room (Fig. 3) in which this apparatus is placed is 48′ 4″ × 87′, and is designed and arranged to receive apparatus to the amount of 4000 hp. Only half this capacity is now installed. This plan was laid out with a view to the occupation of a minimum space, and, although the machines are large for their output, it fairly illustrates the compactness attainable in a plant of this character.

The system of conductors and switches in this plant is so arranged that every piece of apparatus is readily interchangeable with every other, so that the spare pieces are always ready in case of trouble, no matter where the trouble may occur. This, as I have said, is made imperative by the nature of the reduction process in which a shut-down entails heavy loss. The arrangement of conductors and of apparatus is such as to require about the minimum amount of copper under the circumstances. The air spaces below the transformers contain all the conductors connecting the transformers and leading to the outside lines. The conductors from the switchboards on the alternating side of the machines lead downward into the air chamber; the conductors from these boards to the machines lead through open ducts covered by floor plates. On the direct-current side of the machine an open passage is left under the floor which serves as a means of getting at the lower brushes and also provides space for the cables and wiring. The direct-current switchboards are placed above this passage, and the terminals from their backs are bolted directly to the bus bars which deliver the current to the Pittsburg Reduction Company's furnaces.

With some machines of this class there is no difficulty whatever in starting, while with others it is impossible to start from the alternating current alone. The machines here installed will start from the alternating current and come up to synchronism promptly. After one machine is in motion the others will be started from the direct-

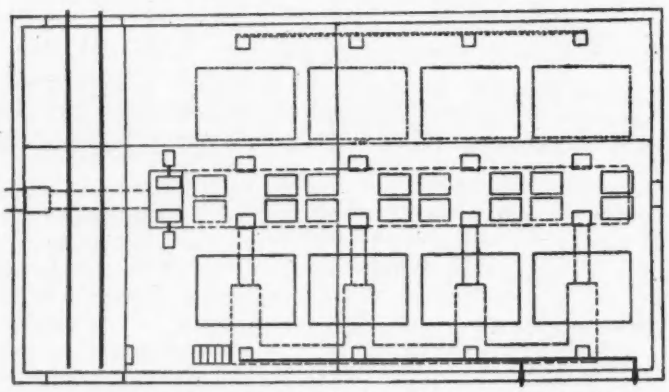


Fig. 3.—Floor Plan, Pittsburg Reduction Company.

current side, a set of connections and a resistance box being installed for that purpose.

In throwing machines of this character into parallel great care must be observed. We must be sure that they are exactly in synchronism, and also that the direct-current polarity is the same. To accomplish this we have arranged a system of phase lamps by which both these points are shown. Each machine is fitted with seven lamps which are required for lighting the room and the machine. Four of these are on the collector side of the machine and are so arranged by switches that they can be connected as phase lamps, two on each side of the two-phase system between the machine and the alternating bus bars. When all four lamps burn together, and the fluctuations of the light become very low, the machine is ready to throw in. If through misplaced switches or wrong connections the polarity of the machine and alternating circuit do not agree, two of the phase lamps will burn while the others are out.

The General Electric Company has installed four cables of 900,000 circ. mils to connect this plant with the main generating station. These cables are lead-covered and insulated with rubber. They are jointed inside the Reduction Company's building to small cables which lead to the switchboards near the transformers.

Another of the important contracts closed by the Niagara Falls Power Company for the delivering of electric power from the Falls is that with the company which manufactures the substance which has been given the name "carborundum." This substance is carbide of silicon; it is of extreme hardness and is used as an abrasive in the same manner as corundum or emery.

This substance is manufactured from a mixture of sand and coke by the application of heat derived from an electric current. The ingredients are mixed together and piled in a furnace between two large carbon electrodes. A current is then passed through the mass which gradually heats. After a high temperature is attained the carbon and silicon begin to combine, and the product collects in crystals on the cooler external surface of the mass. After the process has gone on for about 24 hours, the current is stopped and the mass allowed to cool.

The carborundum crystals are found in a loose crust on the surface. This process presents rather a peculiar electrical problem, since as the furnace heats the resistance diminishes, and since it is desired

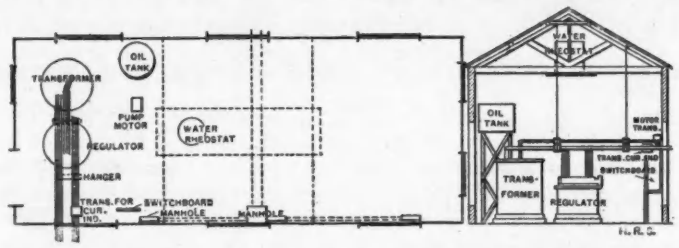


Fig. 4.—Arrangement of Apparatus, Carborundum Company.

to supply a given amount of power continuously to this falling resistance, the amount of power to be delivered in the present case is to be 1000 hp. The pressure required at the beginning of the process is 250 volts, and at the end 100 volts. The current begins at 3000 and ends at 7500 amperes. The power is to be taken from one side of the 2000-volt two-phase system.

A number of different methods of supplying this power were proposed and discussed, and the contract for building the apparatus was finally awarded to the General Electric Company, the fitness of the design proposed being, I believe, the principal ground for awarding the contract. The arrangement of apparatus is shown in Fig. 4.

The chief merits of this apparatus are, first, it works without change of connection or opening of the circuit. Second, it is practically non-inductive at all stages of the process, the apparatus being so designed that the magnetizing currents are small and self-induction is in no way depended upon for the control of the current. Third, the process is continuous, the voltage varying gradually, not in steps. Fourth, the apparatus is controlled automatically.

The apparatus consists in a transformer and a regulator. The former has a fixed ratio of transformation, being built for an E. M. F. of 2200 in the primary and 185 in the secondary. The regulation is virtually a transformer in which the mutual induction of primary and secondary is variable. Its design is somewhat similar to that of an induction motor, there being two concentric parts built of laminations with distributed windings in slots on each. The outer member is fixed, while the inner is movable through an arc of 60°. This angle corresponds to the space between two poles, the windings being so grouped as to form six poles.

In addition to the regular windings, the movable member is fitted

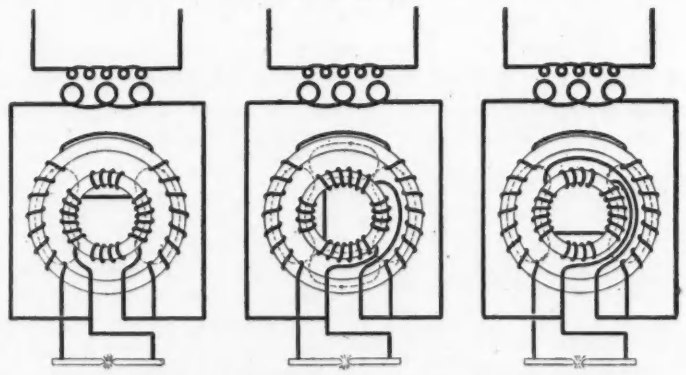


Fig. 5.—Feeder Regulator, Carborundum Company.

with closed turns of low resistance between the poles, so placed as to prevent magnetic short-circuiting when the regulator is in or near mid-position. Thus the regulator is a transformer in which the inductive relation of the two coils is reversible, and in which the mutual induction is variable.

The connections of the transformer and regulator between the line and furnace are shown in Fig. 5. The regulator there appearing has, for the sake of simplicity, been shown with two poles only, and of Gramme construction, while six poles and cylindrical winding are

in reality used. In the diagram the primary voltage is 2500 and the secondary voltage 185, with 4500 amperes: the effective voltage in the three different positions of the regulator are 100, 185 and 250 respectively, and the corresponding current, 7500, 4500 and 3000 amperes.

The transformer and regulator will be connected together and to the furnace by heavy copper bars, suspended above them from the roof of the building. The winding on the stationary part of the regulator is placed in series with the transformer secondary, and that on the movable part is in shunt. The conductors at different points are proportioned to the currents which they carry. Eight bars, 4 inches x ½ inch, of suitable lengths, give the desired arrangement.

At the beginning of the process the resistance of the furnace is at its maximum, the current from the transformer divides, part energizing the movable part of the regulator, the remainder passing through the stationary part of the regulator, the effective E. M. F. being thereby raised from 185 volts to 250 volts.

From this position the regulator is gradually turned as the resistance falls, the result being that the added E. M. F. and the amount of current withdrawn from the circuit by the shunt portion of the regulator both continuously diminish. When the regulator reaches mid-position the two parts have no mutual induction, and the regulator is entirely neutral except that the magnetizing current and losses of its two parts are supplied at the expense of the transformer.

As the regulator passes from the mid-position the resistance of furnace continuing to fall, the E. M. F. generated in the stationary part begins to oppose the E. M. F. of the transformer, and the current in the furnace rises, being now the same as the currents from the transformer, and from the movable part of the regulator.

The regulator is so arranged that it can be turned either by hand or by a motor. In the carborundum furnace the variations of resistance are so irregular that a continuous angular motion of the regulator cannot be used. If the variation of resistance was uniform throughout the process, the regulator could be slowly turned by a properly guarded constant speed motor and would be automatic.

The transformer and regulator are cooled by circulating oil. A pump and two tanks are used, one above the other. The upper tank contains a coil of pipe in which water circulates. It is so arranged that the moving oil must flow over this coil and give up its heat. The lower tank receives the oil from the apparatus, and prevents an overflow in case the pump stops.

In the transformer the oil is admitted at the bottom, and flows upward, through and around the coils, the coils being placed vertically and the laminations horizontally. After overflowing at the top of the coil space it finds its way downward over the outer surface of the laminations. The regulator is so constructed that it revolves in a horizontal plane. The cooling oil flows upward through the air-

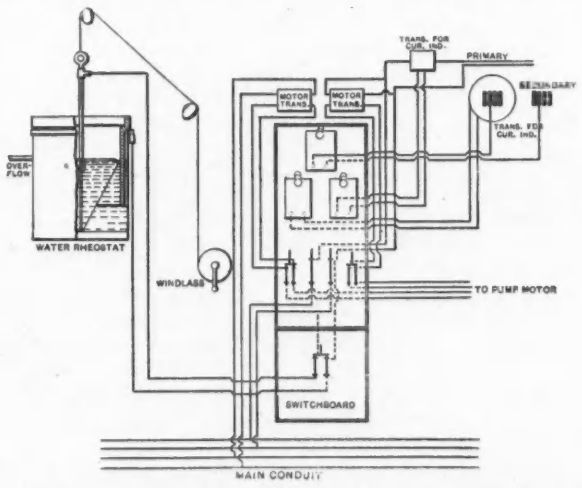


FIG. 6.—DISTRIBUTING SWITCHBOARD, CARBORUNDUM COMPANY.

gap between the two parts, and down over the outer surface of the stationary part and inner surface of the movable part. The transformer is placed in a cylindrical tank, while the regulator is self-contained, the cast-iron supporting shell forming the outer casing.

The oil is lifted by a small induction motor geared to a pump. Since the process is not continuous, some means of opening the circuits must be provided so that the apparatus may be cut out when the process is complete. The arrangements which have been made for this purpose are shown in Fig. 6. A pair of large snap switches is placed, one in each lead from the generating station. In parallel with one of these switches a specially designed water rheostat is placed. This rheostat consists of an iron tank lined by a section of vitrified pipe of large diameter.

This tank is about half filled with water, and a pointed electrode is so arranged that it can be raised or lowered from the water by a rope leading to a small winch. Before the switch is opened the electrode is lowered into the water, which provides a non-inductive circuit in parallel with the switch. After it is opened the electrode is raised, which increases the resistance till the circuit is broken at the surface of the water. The vitrified pipe prevents the possibility of arcing or contact between the electrode and the iron tank.

A switchboard will be installed on which the switches will be mounted, also the switches for controlling the pump motor. Current indicators will be mounted on this board, which show the current in the primary leads, also the current passing to the furnaces. These indicators will be operated from small transformers which encircle the conductors. A voltmeter will also be installed, which will show the E. M. F. at the furnace terminals. This plant will for the present be operated by cables branching from those leading to the Pittsburg Reduction Company's plant.

The Invention of the Electromagnetic Telegraph.

The claim is sometimes heard made in the western part of Pennsylvania that the telegraph was invented by a resident of that section—a Dr. Alter, who formerly lived at Elderton, Pa. In reply to a letter on the subject addressed to Mr. M. H. Alter, of Kittanning, the following communication was received:

"In regard to my father's part in the application of electromagnetism to telegraphic purposes, I have letters in my possession showing that he had communication with Prof. Henry in 1831. This led him to experiment, and the result was that he erected three lines of wire from the barn to his house in Elderton, this county, a distance of about 100 yards, using double lines, as the ground circuit was then unknown. He used three dials, and by the deflection of the index was enabled to transmit intelligence, but I have no record of the manner in which these indices were used. He never completed a system of registration of electrical messages, but rested with the satisfaction of knowing that such results were attainable, which fact he had no hesitation in telling any one curious to know. There is a legend abroad here, which is believed by hundreds, that Prof. Morse obtained his ideas of telegraphy from my father. This is without foundation in fact. He never had any communication with him, never saw him; there is no similarity in the mechanical application of the principle involved, and I would be pleased to have you correct this impression. From his conversation I would say that he gave credit to Prof. Henry as being the prime factor in the development of the electromagnetic telegraphy.

"That he was one of the many whose attention had been directed in this channel, I have no doubt, and, without claiming any recognition for him as a factor in the development of the telegraph, he would yet seem to be worthy of mention in an historical sketch.

"I may add that my father was a man of advanced scientific knowledge, utterly devoid of business sagacity and as bashful as a maiden in asserting any merit he possessed. His mental activity extended in many directions, the new science of electricity possessing a particular attraction for him. In an article in the Kittanning *Gazette* of June 29, 1837, entitled 'Facts Relating to Electro-Magnetism,' he said: 'It will be readily seen that this power will be much more applicable to locomotion than steam,' and proceeded to give details of methods which, of course, have now been surpassed. In 1852, in passing sparks from a static machine of his own construction, he caught the image of the spark in a prism, and wrote the first essay on spectrum analysis, which appeared in the *American Journal of Science and Art* in 1853."

A Large Gas Engine.

It is stated by the *Gas World* that a gas engine has been built at Rouen capable of furnishing 320 indicated horse-power with fuel gas or 450 horse-power with coal gas.

The "Vzryv."

One of the Russian torpedo boats has the above consonantial name. To pronounce it, you inhale red pepper and stand on your head.—*American Engineer*.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

12,500-Volt Generator.—According to the Lond. "Elec. Rev.," Oct. 25, an alternator of 12,500 volts, built by Ferranti, has been installed at the Deptford station; its capacity is 1000 kw; the voltage is believed to be the highest ever developed by a machine; it was recently connected in circuit for six hours and ran remarkably steady; no further information is given.

Control of Transformer Losses.—The Lond. "Elec. Rev.," Oct. 25, contains the first part of an article by Mr. Whitcher in which he discusses the subject of reducing the constant losses in transformer systems. The language used is not very clear and it is not apparent from the present portion what conclusions he intends to arrive at. He states that "in a system combining the series and parallel characteristics, there would be no constant losses. This, in fact, is what a certain case of my system, in a measure, achieves." He gives a table of efficiencies of a plant consisting of four transformers grouped in various ways, for various loads, showing a great reduction in the constant losses at small loads by various methods of grouping. He enumerates the four different ways in which regulation may be effected. Frst, in large sub-stations, by dividing the plant into units of convenient size which may cut in and out of circuit; second, with small sub-stations each with a group of trahsformers and with switches which can be operated by an attendant going around with a key; third, large or small sub-stations with a group of transformers or a sectional transformer, with switches arranged to operate by an automatic mechanism brought into action by variations in the load. The fourth appears to be his own method and consists in using large or small sub-stations controlled by switches actuated by energy transmitted from the central station and therefore requiring at least one extra conductor, but he suggests that the pilot wires may be used, and if there is always a voltage on the mains, then simply short-circuiting the station ends of the pilot wires would put the switch motor into action, thus placing the sub-station under direct contro' of the station engineer; the method was used effectively at Oxford. The Whitcher system was discussed briefly in the Digest, July 28 and Aug. 4, 1894, and Jan. 5, 1895.

Iron Losses in Transformers.—Mr. Hay, in a communication to the Lond. "Elec.," Oct. 25, criticises the recent article of Mr. Feldmann (see Digest, Nov. 9). He believes that Feldmann's references probably referred to the article of Mr. Still (see Digest, Dec. 1, 8, and 15, 1894), and not Mr. Hill. The whole article is marred by a blunder, as he differentiated instead of integrated; it must therefore be rewritten to be of any value.

Multiple-Circuit Arc Light Dynamo.—A brief, illustrated description of a new machine, devised by Prof. Elihu Thomson, is published in the "Elec. Eng.," Nov. 6. It is a direct-connected multipolar dynamo intended for a series of arc light circuits, in which the regulation of each circuit is said to be as simple as in the ordinary machines; a series of lamps may be run on each circuit; it has a revolving set of multipolar field magnets, while the armature is stationary and has circuits "of three coils or three-phase windings, from which three terminals are carried out;" the commutators "are driven synchronously with the machine, or at higher rates;" "the commutator is virtually bi-polar, or if the commutator is for four poles, its speed would be one half as great;" if there are 12 field coils, the commutator would revolve six times as fast, if bi-polar, as the machine; each commutator carries three rings for connection by brushes to the stationary windings; "reactive coils, constant-current transformers, etc., may be inserted between the connections from the stationary windings and the commutating devices, and the transformation of potential up and down may be at the same time accomplished, if transformers are employed. While the machine is thus primarily adapted to work a number of circuits of arc lights, it may be on occasion employed to operate three-phase motors or three-phase lighting circuits, or may be used in various transformer combinations to operate two-phase or other polyphase systems."

Three-Phase Rotary Field.—The "Elec. Jour.," Oct 15, contains an article by Prof. Jackson giving the results of measurements made some time ago of the magnetism of a rotary field; continuous currents of the proper value were passed through the three field circuits; a coil of wire was placed on the armature and the number of lines passing through it were determined in different positions as also the corresponding magnetizing currents. The curve is quite similar in form to a sinusoidal one; the maximum values of the different curves are nearly equal showing that the maximum value of the rotary field is constant and the apparent rotation of the maximum poles appears to be about uniform.

LIGHTS AND LIGHTING.

Street Lighting by Arc Lamps.—A translation of a long paper by Prof. Blondel from *Genie Civil* is begun in the Lond. "Elec.," Oct. 25; it is of the nature of a treatise on the subject of illumination of streets with arc lamps, and shows how the illumination from one or more lamps may be calculated; it appears to be an excellent article, but does not admit of being abstracted; some of the data given may be of interest here. The result of more intense lighting on more important streets of a city accustoms one to better illumination and makes other streets seem darker by contrast which therefore necessitates the extension of such increased illumination; he uses throughout the system of photometric units which he proposed, and which were fully described in the Digest, Aug. 11 and 25, Sept. 22, Oct. 20, Nov. 3, 17 and 24, 1894; he gives the following figures for the illumination of streets in terms of the unit lux; full moon 0.17 to 0.1, Batswing burner 0.12, regenerative burner 1.29, electric arc 2.0 to 3.5, minimum illumination necessary for reading 10, illumination in picture galleries 10 to 30, mean illumination for reading by daylight 50, illumination of a surface on which the rays of the sun strike normally 70 to 100. He considers the arc lamp the only means of illumination for obtaining good lighting as a whole in important streets; Paris has only 313 arc lamps in public use while New York has 2621. He discusses at length how the arc light should be used to obtain the best illumination, giving first the general principles and then their application for the best means of distributing and diffusing the light; there are two different points of view, the physical or photometric and the physiological, the latter being far too often neglected. He discusses the distribution of light from a single arc remarking that the mean spherical luminous intensity is a "useless artificiality," and is a continual source of error; he discusses the illumination of a horizontal plane giving tables for facilitating the calculations; he discusses the influence of the height of the lamp giving the following as the proper heights in order that the light should give the maximum illumination at a given distance l; the height is equal to this distance l multiplied by the following factors: for a naked continuous current lamp 0.95, for the same lamp with a ground glass globe 0.85, with an opaline globe 0.85, and an opal globe 0.50 to 0.80, for a holophane globe 0.50; these heights are considerably less than those derived from the classical formula in which the constant is 0.70 and he considers that great errors will be committed by using the latter formula. He then discusses the resulting illumination from many sources of light, showing how curves of equal illumination or "isolux curves" may be drawn. He shows the importance of taking into account the illumination of a vertical plane, as objects on a street are illuminated by it; the statement that in most cases the illumination on a vertical plane is greater than that in a horizontal, is true only for a single lamp, but not for several, for which the horizontal is the sum from different lamps, while the vertical may not be the sum of the vertical ones; the normal illumination to which importance is given by some writers (presumably meaning the illumination on a plane perpendicular to the ray) he states is only of theoretical interest and not to be considered in practice.

Train Lighting.—The article by Mr. Staberow (see Digest, Oct. 5) describing in detail the installation on the Dortmund line is concluded in the "Zeit. f. Beleucht.," Oct. 15. The first cost and cost of operation are given in detail; the latter shows that the average cost for a 10-cp lamp is 2.7 pf., which is equal to about 0.7 cent, if to this is added interest at the rate of 4 per cent. on first cost, and 3 per cent. for amortization, this cost amounts to 6.33 pf., which is equal to about 1.6 cent.

Electric Lighting at the Exhibition of 1900.—"L'Elec.," Oct. 26, begins a reprint in part of a paper, by Mr. Dumont, discussing this subject and pointing out the importance of having the exhibition well lighted; it discusses the lighting of the preceding French exhibitions and estimates that for the next one at least 1200 hp will be required, which is three times as much as in the exhibition of 1889; the article is largely of local interest only.

Back E. M. F. and True Resistance of the Arc.—A British Association paper by Prof. Ayrton and Mr. Mather, noticed very briefly in Lond. "Engineering," Oct. 25, shows that there is no conclusive evidence of the often suggested steady back E. M. F.; it is at any rate less than the usually quoted 10 volts; "the authors proceeded by taking, in an arc circuit, two points of equal potential, and applying a difference of potential to them

from the outside. When the ratio between a small increase of potential difference to a corresponding increase of current was taken to determine the resistance between the points, a negative resistance resulted, which is not surprising." No further information is given.

Arc Lamp.—The Barriere lamp is described and illustrated in "L'Elec.," Oct. 26; the principal features are that it is regulated by means of a band brake and the coils are constructed so as to be very sensitive; the mechanism is quite simple. It is possible to use it with a current as small as one ampere, either direct or alternating, and the regulator may be placed below the arc to adapt it for a table lamp; with extremely small currents the striking of the arc is effected by hand; the regulator includes a make-and-break contact; it is said that the variation in voltage does not exceed three volts.

Lighting with Primary Batteries.—In the "Elec. Age," Nov. 2, Mr. Harrison in a brief article argues that when low watt incandescent lamps are used it is within practical limits to use small primary batteries; four bichromate cells with large carbon surface can keep an eight candle power, eight volt, one watt lamp, lighted steadily for eight hours.

Alternating Arc.—Some of the illustrations from the paper of Mr. Georges, which was abstracted in the Digest, Sept. 28, are reprinted with a brief description in the "West. Elec.," Nov. 9.

POWER AND HEAT.

Water-wheel Governing.—The Lond. "Elec. Eng.," Oct. 25, contains a short, illustrated article by Mr. Handy in which he describes a simple form of regulator with which very good regulation was obtained. It consists essentially of a double coil, one part of which is connected as a shunt, to the terminals of the dynamo, and the other part is in series, in the main circuit, their action opposing each other; they attract a plunger which operates a rocking lever which in turn closes a mercury contact at one end or the other depending upon the position of the lever which in its middle position does not close either; a current from a small storage battery passes through these contacts when closed, and operates either one of two electromagnets, which in turn release a pawl on one or the other side of a lever kept rocking by means of an eccentric operated by the turbine; when one of these pawls is released the oscillating lever turns a ratchet wheel in one direction while if the other pawl is released it turns it in the other direction, the ratchet wheel being connected to the gate of the water-wheel; when running at a normal speed neither of the pawls engage in the ratchet wheel. The effective regulation of the governor is shown by a curve which was taken while the load varied over the full range, the difference between the highest and the lowest reading of the voltage being only two volts.

Jib Crane.—An electric crane used in the Sandycroft foundry, is described and illustrated in the Lond. "Elec.," Oct. 25; one of the chief features is that the steel billets weighing one ton are held to the end of the chain by means of a large magnet weighing 300 pounds taking 5.5 amperes at 110 volts and which will then lift over two tons; it has been in constant use for several months, and enables three men in one quarter of an hour to do what formerly required six men one hour and a half, the saving of time being chiefly due to obviating the necessity of chains for holding the billets.

TRACTION.

Electric Traction in Rome.—The Lond. "Elec.," Oct. 25, gives a few particulars regarding a new line which was recently started, and which is of special interest as the power is derived from an alternating current supplied mainly from the well-known Tivoli-Rome transmission plant. The line is 1.8 miles long, and there is a five-minute service of seven cars; American machinery seems to be used, but there is an additional switch enabling the motors to be short-circuited so as to act as brakes; 300 volts are used, and the necessary transformation is obtained by means of high speed dynamo-motors having a multipolar field and a single armature connected to two collecting rings on one side and a commutator on the other, the continuous-current generator being used to charge a storage battery, which in turn supplies power to the line; everything is working satisfactorily.

B. & O. Locomotives.—Some further tests are described in the "Elec. Eng." and "Elec. Rev.," Nov. 6, and "West. Elec.," Nov. 9. Trains have been handled promptly and there have been no delays. Some weeks ago a test was made, the trains consisting of two steam locomotives not working and 27 loaded freight cars which were brought to a stop in the tunnel where the grade is 42 feet to the mile and the rails damp and greasy; the weight of the train, including the electric locomotive, was 1221 tons; after one minute the speed was 10.5 miles an hour; the total distance moved in 40 seconds was 150 feet and after one minute 450. A few days ago a test was made with a dynamometer between the locomotive and the train, which consisted of 22 loaded cars and two locomotives, the total weight being 1068 tons; on the 10 per cent. grade the average pull was 25,000 pounds, the speed being 11⅛ miles per hour, the pull being remarkably uniform and steady; with another train weighing 1600 tons the drawbar pull was 45,000 pounds. In another test a train weighing 1900 tons and 1800 feet long was started from rest in the tunnel and consisted of 28 loaded cars and two locomotives coupled to a local train of 15 loaded cars and one locomotive; the drawbar pull was 60,000 pounds; the train was soon brought to a speed of 12 miles an hour, the drawbar pull being 40,000 pounds. No train which will hold together has been found heavy enough to cause the locomotive to slip under fair conditions. An extension of the overhead work is being planned; two additional machines are nearing completion, after which the passenger service will be undertaken by them.

Modified Three-wire System.—The Potter high-voltage system is briefly described and illustrated in the "Elec. Eng.," Nov. 6, 1000 to 1200 volts are used between the outside mains, but the station apparatus is of the standard 500-volt type; four motors for 500 volts are used on the cars, two on each side of the system; the neutral point is grounded through the rails as is also the neutral point at the power-house; there are two trolleys required; the main current does not flow through the earth or rails, except when one pair of motors is slightly out of balance with the other pair; bond wires may therefore either be dispensed with or replaced with very light ones; where the lines enter a city one of the trolleys may be withdrawn and the motors operated all four in series between one of the lines and the ground, at 500 volts, as usual.

Electric Car Tests.—The serial by Prof. Hermann Hering is continued in the "Elec. Ry. Gaz.," Nov. 2; he gives a large number of curves and tables of data for the performance of cars over the entire route under the conditions of actual service; the cars were equipped with Westinghouse, General Electric and Edison systems; the results give the time interval, mean speed, total watt-hours, watt-hours per car-mile and the electric horse-power for the outgoing, return and entire trip; he also gives speed records of a horse car and a cable car.

Accumulator Traction.—According to the "West. Elec.," Nov. 9, the first large railway in the United States using accumulators will soon be constructed in Chicago; no technical data is given; many of the members of the syndicate are prominent stockholders in the Electric Storage Battery Company, of Philadelphia, whose batteries will doubtless be used.

Electric Carriage.—The new carriage of Morris & Salom called the "Electrobat" is illustrated and briefly described in the "Elec. Rev.," Nov. 6; the makers represent the Electric Storage Battery Company. It has two Lundell motors of 1.5 hp each, attached to the front axle, by means of gearing; it is steered by the hind wheels and can be turned completely around in a circle 20 feet in diameter; the front driving wheels are 40 inches in diameter and the rear 28; both have pneumatic tires and ball bearings; there are four sets of accumulators of 12 cells each, having a capacity of 50 ampere-hours; the controller gives four speeds ahead and one backward, and they are obtained by grouping the motors and batteries; it has a maximum speed of 20 miles an hour on a good road, and the capacity would suffice to drive it 25 miles (but at what speed or during what time is not stated, presumably not at 20 miles per hour;) its complete weight with batteries is 1650 lbs. A smaller one was also built and will take part, together with this one, in the Chicago races; it is similar, except that the wheels are made like bicycle wheels and that the complete weight is 1180 pounds; it is claimed to be the lightest electrical road carriage ever built. In the recent preliminary race the Mueller gasoline motor carriage won the purse of $500, covering 92 miles in 8 hours and 50 seconds. A list of those expected to take part in the final test is given.

Brooklyn Bridge.—According to the "Elec. Ry. Gaz.," Nov. 2, the officials of the bridge have asked for bids for an electric system to switch the trains at the terminals; one car of each train will be equipped with motors and the controllers will be placed on the front and rear cars so that the train may be operated from either end; it is to be used only at the terminals to replace the present steam locomotives; the overhead system will probably be used; during busy hours about 75 trains an hour are operated at present.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Statistics for Large German Cities.—The article, the first part of which was abstracted in the Digest, Oct. 26, is concluded in the "Zeit. f. Beleucht.," Oct. 15; tables containing various data, which cannot be abstracted, are given more particularly for the stations at Cassel and Duesseldorf; the prices charged for current in large German cities are also given, but owing to the complicated system of rebates they cannot well be compared; another table gives the receipts and expenses for five large stations.

Coatbridge Gas Engine Station.—An illustrated description of this station is published in the Lond. "Elec.," Oct. 25; it is of interest, as gas engines are used to drive alternators, all the gas engines being coupled to the same shaft; there are two gas producers, each capable of generating 120 hp; the gas engines are started with steam, which is admitted in timed impulses.

Edinburgh.—The first part of a long paper by Mr. Burstall read recently

before the Institution of Mechanical Engineers, and descriptive of this station, is published without illustrations in the Lond. "Elec. Eng.," Oct. 25.

Storage Batteries in Office Buildings.—In a paper by Mr. Blizard in the "Elec. Eng.," Nov. 6, he reviews the well-understood advantages of the storage batteries in connection with plants in office buildings and gives an estimate to show the saving resulting from the addition of a battery. He believes that a battery would be a very profitable investment in a large proportion of the office buildings and that in many cases the saving would be from 25 to 60 per cent. per year on their first cost; the plant which he takes as an illustration has a dynamo of 200 and another of 400 amperes running during the day and early evening, while at night the current is taken from the street; a battery for this plant would cost $3000 which would deliver all the current during the night and reduce the running time of the generators by two hours; charging would require eight hours; including a depreciation of 7.5 per cent. he finds that the saving will be $1202.57 which is 40 per cent. of the first cost of the plant while in addition there will be a saving in labor, depreciation, etc. As a sample of the space occupied by a battery he states that a 100-light plant could be set up in a room eight by ten with five feet head room.

WIRES, WIRING AND CONDUITS.

New French Cable.—The Lond. "Elec.," Oct. 25, comments on the recent announcement regarding the new cable from Brest to New York, which is to be made and laid by a French company. Editorially it seems to doubt whether the company can do what it claims; a cable to be high speed must have a capacity of at least 40 theoretical words per minute and if that company can lay and maintain a cable of 3400 nautical miles and a speed of over 30 theoretical words they will accomplish something beyond anything which has ever been done.; it is estimated in the editorial that this would require a core of about 1200 pounds of copper and 1000 pounds of guttapercha per nautical mile, and it concludes that besides the cost, the mechanical difficulties alone would be enough to condemn the scheme; it is believed the French company has not sufficiently realized the enormous weight of such a cable and the series difficulties of transporting and repairing it.

Copper Telegraph Wire.—The "Eng. & Min. Jour.," Nov. 2, extracts from the annual report of the Western Union Telegraph Co. showing that during the year ending June last it has added 11,859 miles of wire, of which over 10,000 miles were copper; the company has adopted the policy of replacing all defective iron wires with copper, the intention being to use that metal alone for all the principal lines; the advantages in weight, increased capacity for transmission and diminished liability to interruption from atmospheric conditions, suffice to make it more economical notwithstanding the greater first cost; the size of copper wire used for telegraph lines is generally No. 9 or 10 B. & S., weighing about 199 pounds to the mile.

Safety Appliance for Dangerous Currents.—The Hutchins method is described and illustrated in the "Elec. Rev." and "Elec. Eng.," Nov. 6, and in the "West. Elec.," Nov. 9; it consists essentially of a forked grounded wire placed on each pole, below dangerous wires, so that when the wire breaks between two poles it falls into the fork and is thereby grounded.

ELECTRO-PHYSICS AND MAGNETISM.

Graphical Calculations for Currents of any Wave Form.—The first part of an article by Dr. Roessler is published in the "Elek. Zeit.," Oct. 24. The graphical methods at present in use for treating alternating-current problems by means of vector diagrams, are based on the assumption of sine curves and do not consider hysteresis, but as this does not represent the practical conditions such methods are not satisfactory; in the present paper he describes a method by means of which the conditions may be represented by vector diagrams for the most general case, that is, for any wave form by merely representing the amplitude of the sine wave by the quadratic mean value (that is, the square root of the mean of the squares) of the periodically varying quantity; the effective hysteresis can also be introduced in a very simple way. He shows how the conditions may be represented graphically for a simple circuit which contains besides an inductionless resistance, a coil surrounding iron, as, for instance, the primary winding of a transformer. If the quadratic mean of the voltage at the ends of the total resistance is E, the current C and the E. M. F., which is introduced in the primary winding of the transformer by the periodic changes in the magnetism of the iron, E, then these E. M. Fs., together with the product of the current into the total ohmic resistance can be represented by the three sides of the triangle (not necessarily a right angle triangle) which has the property that the simple mean value per second of the power at the terminals is equal to $E\,C\cos a$ in which a is the angle between the lines representing E and the product of the current into the total ohmic resistance; "this angle a enters in the same way in the well-known equation for the apparent and the true effect of an alternating current, as with sinusoidal changes of the angle of the phase shifting between voltage and current." He proves the correctness of the above equation algebraically.

Charging of a Condenser.—The Lond. "Elec.," Oct. 25, contains an article by Mr. Hay in which he discusses the subject of charging, showing that the charging current under certain conditions will also undergo a series of oscillations; he shows that the theoretical and experimental curves are in substantial agreement; the chief interest in the experiments described is not so much that they show the existence of oscillations in the charge but that they enable one to make a fairly accurate quantitative comparison between the actual curves of current and voltage and those deduced theoretically.

Effect of Magnetization on the Electro-Chemical Properties.—In a paper by Mr. Hurmuzescu abstracted briefly in the Lond. "Elec.," Oct. 25, from the Journal of the French Physical Society, he states that he has at last with the aid of the capillary electrometer obtained consistent results and finds that iron is always made positive by magnetization; nickel behaves in the same way but bismuth is made negative.

Magnetic Forces Inside of a Closed Circuit.—Mr. Russell in the Lond. "Elec.," Oct 25, points out the error in the formula of Mr. Collard (see Digest, Nov. 9).

Hysteresis.—The Lond. "Elec. Eng.," Oct. 25, publishes a translation of the short article of Mr. Friese, mentioned in the Digest, Nov. 9.

Resistance of Bismuth at Low Temperatures.—The article by Messrs. Dewar and Fleming abstracted in the Digest, Sept. 21, is being reprinted in "El'ty.," beginning with the issue of Nov. 6.

Influece of Cold on Magnetism.—Some of the data from Mr. Pictet's paper, which was abstracted in the Digest, March 16 and 23, is given in the "West. Elec.," Nov. 9.

ELECTRO-CHEMISTRY AND BATTERIES.

Preparation of Pure Iron by Electrolysis.—A British Association paper by Prof. Hicks and Mr. O'Shea is reprinted in the Lond. "Elec.," Oct. 25. They recently had occasion to prepare considerable quantities of pure iron by electrolysis, and as the process is tedious, costing much time and trouble to get the best conditions, they show what the difficulties are and the means to overcome them. It is absolutely impossible to obtain coherent masses if the solution contains free acid; the electrolyte was a 5 per cent. solution of crystallized ferrous chloride to which was added sufficient ammonium chloride to form the double chloride; the amount of iron salt in the solution should not be allowed to get too low as it then becomes alkaline and ferrous hydroxide is precipitated; the iron salt in solution should not fall below 20 to 30 per cent. of its original strength, and to avoid this they made daily determinations by titration adding ferrous chloride when necessary. The solution must be free from ferric compounds as this leads to the formation of ferric hydroxide accompanied by frothing, but it ceases when the whole of the ferric compound is decomposed, which takes place after the current has passed for some time; they overcome the difficulty by shaking the ferrous chloride with reduced iron and filtering. For the best results both voltage and current density must lie within certain limits; they started the deposit with a current density of 0.2 amperes per 100 sq. cm and when the cathode was completely covered this was reduced to from 0.15 to 0.18; it is possible to considerably reduce the density; the current was obtained from a single storage cell in series with a cell of dilute sulphuric acid and lead electrodes, which reduces the voltage to nearly the right value; a small external resistance regulated the voltage to about 0.7 volt. The cathode was made of the finest procurable copper sheet, mounted on a sheet of glass and very thoroughly cleaned with nitric acid, sand and an excess of a strong potassium cyanide solution, being sure to have an excess of it or otherwise a film of copper cyanide may be left. The cathode must be completely immersed or copper will be dissolved; it is therefore covered on the back, and wherever else necessary, with Brunswick black; the anode consists of rolled Swedish iron, containing some sulphur and carbon, and enclosed in a porous cell which collected the carbon while the sulphur went into solution, forming sulphuric acid; the solution in the cell was therefore changed twice a day, and this enabled the iron to be obtained quite free from sulphur. With these precautions a firm, incoherent deposit of iron was obtained, of almost silver whiteness and a velvety appearance, but containing numerous small holes due to the formation of bubbles, to avoid which they suggest raising the plate out of the solution occasionally for a few seconds; the iron was deposited at the rate of about three grammes per 100 sq. cm in 24 hours; the process worked continuously.

Alternate-Current Electrolysis.—In the Lond. "Elec.," Oct. 25, Mr. Cooper gives an illustrated abstract of a paper by Dr. Hopkinson and Messrs. Wilson and Lydall on this subject, which was read before the Royal Society in 1893, and which shows how readily a difference of phase can be obtained when the electrodes are close together and the impressed voltage is not large, the main object of the paper having been to determine the efficiency of an electrolytic cell used as a condenser and to give some idea of the thickness of the coating of the ions which is sufficient to give complete polarization. The results of these experiments give an efficiency varying between 23 to 43 per cent. with plates 0.125 inches apart. They arrive at the conclusion that about one tenth of a coulomb suffices to fully polarize 150 sq. cm of platinum or that 0.00000007 grams of hydrogen is sufficient for one sq. cm of platinum from which it is inferred that this number of cm is probably a magnitude comparable with the distance between molecules of hydrogen when this body is compressed to a density comparable with the density of liquids.

Electrolysis and Electro-Syntheses of Organic Compounds.—A long article by Dr. Loeb giving what seems to be a good summary of the subject, is published in "Zeit. f. Electrochem.," Oct. 20; it is very rich in references to the original articles, to the number of 125.

Electrolytic Copper Refining in North America.—The Lond. "Elec.," Oct. 25, translates from the German a paper by Mr. Sederholm.

Prevention of Evaporation in Batteries.—In a communication by Mr. Dietrich in the "Elek. Zeit.," Oct. 24, he refers to a recent published statement that if the liquid in Leclanche cells be covered with a layer of paraffine oil, the evaporation and therefore the crystallization of salts is prevented; he shows that the same results may be better accomplished by filling the cell, which in this case was a zinc-carbon cell, with a 5 per cent. solution of sal-ammoniac and 5 per cent. of glycerine; after seven months of use he found that the results were very satisfactory. He discusses the relative advantages of the two methods; he claims that glycerine prevents crystallization even though there may be evaporation as it has the property of preventing crystallization even in concentrated salt solutions; he shows that it is simpler and cheaper to use glycerine in preference to paraffine oil, besides being much cleaner; accurate measurements of the internal resistance were not made, but he finds that neither the E. M. F. nor the current were diminished by the introduction of the glycerine; analysis showed that during seven months' time practically none of the glycerine was consumed; he does not approve of a solution containing more than 5 per cent. of sal-ammoniac and even considers it as injurious because the saturated solution increases the tendency to crystallize and the formation of salts of zinc and chlorine.

Storage Battery.—Prof. Anthony in the "Elec. Jour.," Oct. 15, replies to the recent answer of Mr. Barnett (see Digest, Oct. 12). Mr. Barnett assumes $100 per hp for installing direct-supplied machines, to which Anthony replies that in 50-hp units it can be put in for $50 per hp; he questions whether there are users of batteries who find that the depreciation is less than that of boilers, engines and dynamos; he states that the chloride cell is a lead oxide battery, as that phrase is usually understood; batteries largely in excess of the maximum number of cars on a line must be furnished in order that there may be a stock of batteries to draw from during busy hours, and this excess of batteries he believes would cost more than the plant it would save; he objects to the comparison with underground construction for a rate of two cars per mile as no line using so few cars would use an underground construction; eight cars per mile is not much for a city line where underground construction would be required; he did not take into account the smaller interest charge and smaller cost of power because he saw no reason to believe that any such a saving is effected.

Rooney Accumulator.—A description of this battery is given by Mr. Rooney in the "Elec. Eng.," Nov. 6; the main object of the construction is to avoid short circuiting. A grid of some porous, non-conducting substance, contains perforations or receptacles arranged in parallel rows which are filled with active material; along the sides are perforated lead strips which are held in contact with all the pellets of active material in one row, and serve as the conductor, the rows being alternatively of opposite polarity; he calls it lamellose. For the grid, he uses paper board treated with caustic soda forming a grid of very light weight and capable of absorbing a large amount of liquid; the plates are kept a small distance apart by metallic separators which also serve to conduct the current between the plates and to keep the strip firmly pressed against the pellets; there are no bolts extending through the plates and the strips are said to be easily replaced; the active material cannot be dislocated, and bending or buckling is impossible; an illustration is given.

Covering Platinum with Platinum Black.—Prof. Carhart in the "Elec. Jour.," Oct. 15, describes the following method which he believes is not generally known; a saturated solution of zinc sulphate was electrolyzed between platinum plates for six hours with a current of 0.1 ampere, about 100 sq. cm of platinum being exposed at either electrode; the cathode, which was covered with zinc, was left standing in the solution about 24 hours after which it was found to be covered with a firmly adherent coating of platinum black, which, it is claimed, forms part of the surface as distinguished from being applied to it.

Chlorine and Alkaline.—Some further data regarding the Castner method (see Digest, Oct. 26) is reprinted in the "Jour. Frank. Inst." for November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Movable Coil Galvanometer.—The "Elek. Zeit.," Oct. 24, contains an article by Dr. Classen in which he shows how to calculate, from given data of one of these galvanometers, how the dimensions must be changed in order to obtain an instrument of the same sensitiveness which may be used for all purposes and which overcomes the difficulties regarding damping; the kind of instrument referred to is the Deprez galvanometer (which is generally known in this country under the name of the d'Arsonval and contains a coil moving in the field of a strong permanent magnet, like in the Weston instruments). The most important results of his calculations are as follows: To increase the sensitiveness, the horizontal dimensions of the coil should be made as small as possible; the magnetic field must not be made too strong—that is, it must not be generated by electromagnets, and the suspension should be made as fine as possible; it would probably be best to use aluminum wire for the coil as its greater resistance can be balanced by using a stronger field and with its higher resistance the damping would become less, for which reason a stronger field becomes allowable; the development of such instruments he believes should be in the direction of increasing the sensitiveness and the ease of handling it, to such an extent that the instrument will be equivalent to the best astatic mirror galvanometer; up to the present time this limit has not yet been reached because the magnetic fields used were too strong, for which reason strong torsional forces had to be used in order that the damping should not be too great, the greatest sensitiveness could therefore not be obtained.

An Extremely Sensitive Galvanometer.—"L'Eclairage Elec.," Oct. 19, contains an article by Mr. Weiss, in which he gives a description of his new galvanometer (see Digest, May 11 and 18) in which the equivalent of two short horizontal astatic needles is obtained by means of two long parallel vertical magnets; he discusses the effects of certain factors on the sensitiveness of a galvanometer.

Measuring the Insulation Resistance of Storage Batteries.—A simple method is described by Mr. Jacob in the Lond. "Elec.," Oct. 25; the result gives the joint resistance of all the earths at whatever points of the battery they may be situated. A sensitive high-resistance galvanometer is connected to earth and to any point of the battery, so chosen as to give a large deflection; the resistance is then inserted in the galvanometer circuit, reducing the deflection to one half of its former value; the insulation resistance will then be equal to the product of the second current and the galvanometer resistance in the second case minus the same product for the first case, the whole divided by the difference between the two currents; the results are true under every condition. The same method may be used for a complicated network of conductors, as for instance the five-wire system, while current is passing.

Measuring Dielectric Constants.—A paper by Mr. Lefevre is reprinted in "L'Elec.," Oct. 26. He gives the results of measurements of a number of dielectrics and also shows the increase of the constant with time; the method used was to place a slab of the body between two parallel plates connected to the source, one of which is movable, enabling the attraction between them to be measured, first when the dielectric is air and then when it is the dielectric to be measured.

Location of Submarine Cable Faults.—In the Lond. "Elec. Rev.," Oct. 25, Mr. Medlyn describes an apparently simple Wheatstone Bridge method in which the counter E. M. F. in the fault is reduced to an equivalent resistance.

Alternating-Current Motor-Meter.—The "Elek. Zeit.," Oct. 24, reprints a long lecture by Dr. Bruger in which he expresses the opinion that meters operated by motors have great advantages over those of the other types, and discusses at some length their theory; in conclusion he gives an illustrated description of a meter of this kind for alternating currents, devised by him; the two fields which cross each other are so constructed that the phase shifting between them is as great as possible, and the difference between the two field intensities is as large as possible; the constant field is generated by a laminated electromagnet, the armature of which nearly closes the magnetic circuit, the field being wound with fine wire, while the field perpendicular to this is generated by a small series solenoid; the meter starts with about 1 per cent. of the maximum current and begins to read correctly at about 4 per cent. of this maximum; numerous devices are used to overcome the difficulties; friction is overcome by making the constant field slightly unsymmetrical so that this field itself generates a slight torque, just equal to the friction; the watts consumed in the shunt circuit is in general not more than 4 to 5; he shows that the meter may be used for circuits containing motors.

Hookham Meter.—The article mentioned in the Digest last week is concluded in the "Elec. Rev.," Oct. 25. Some further data is given to show the results obtained with a continuous-current meter, which is followed by a description of the alternating-current meter. Portions of reports of Mr. Swinburne and Mr. Crompton are quoted and are very favorable; Mr. Crompton says that for ordinary dwelling houses the meter would register 98.6 per cent. of the energy actually supplied and in shops, warehouses, etc., 99.4 per cent.

Photometer.—A very long paper read before the recent annual convention of the American Gas Light Association, by Mr. Humphreys, is reprinted in full in the "Prog. Age" Nov. 1. In a number of appendixes to the paper, are given, among other things, an index of standard works and numerous references, a comparative table of standards and a well-illustrated description of the Dibdins 10-candle pentane lamp taken from the "Jour. of Gas Lighting," May 14, 1895.

Photometer.—The serial by Prof. Thomas is continued in the "Elec. Jour.," Oct. 15. The Harcourt pentane standard is briefly described; he considers the chimney a weak point as it also gives rise to errors on account of reflected light; he thinks it may be possible to produce a better standard with acetylene. The Rumford and Bunsen photometers are described briefly.

Differential Meters.—The Barstow device is described and illustrated in the "Elec. Eng.," Nov. 6; it consists essentially of two meters having different readings, one for the day load, for which a cheaper rate is to be

charged, and the other for the night load, and a clockwork for measuring time and throwing either meter into action at a predetermined time.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Transmitters.—The Deckert or the "Hunningscone" transmitter is described and illustrated in the Lond. "Elec.," Oct. 25; the back electrode is moulded so as to form a number of pyramidal projections, the object of which is to prevent the backing of the carbon granules. Another form is illustrated in the same journal in which the same object is accomplished by rotating the transmitter, which is done automatically by the lever on which the telephone is hung; the "Elec. Eng.," (N. Y.) Nov. 6, contains an illustrated description.

Railway Signaling.—A long, illustrated paper by Mr. Grafton is published under separate cover from the "Bul. of the Univ. of Wis.," Vol. 1, No. 6; it is not limited to electrical signals.

European Telephone Service.—The recent table from the Lond. "Elec. Eng." is reprinted in the "Elec. Jour.," Oct. 15.

Telephotograph.—A brief description of this Swedish instrument, which was described in the Digest, Sept. 14, is given in the "West. Elec.," Nov. 9.

MISCELLANEOUS.

Addition of Lead to Copper.—The Lond. "Elec. Eng.," Oct. 25, states that the addition of a small quantity of lead to copper, for increasing its fluidity, is the subject of a recent patent; from 0.5 to 1.5 per cent. of pure lead is added and it is claimed that it detracts but very little from the conductivity of the metal, far less than either tin or zinc.

Death by the Electric Shock.—A discussion of the subject, which was started by the recent Institute paper of Dr. Bleile, has been going on in the London "Lancet." The Lond. "Elec. Rev.," Oct. 18, criticises unfavorably the views expressed therein by Dr. Schettle, who ascribes the effects to the physical and mechanical effects of the current on the component substances of the body, and speaks of a supposed "magnetic charge" in the arterial blood, he having found that venous blood suspended in a medium of arterial blood is diamagnetic, and *vice versa*. The views of Dr. McClure (see Digest, Oct. 26) are also criticised unfavorably. The opinion is expressed that the explanations offered by these two correspondents are opposed to the known facts of electrical sciences.

Treatment in Case of Accident.—"L'Ind. Elec.," Oct. 10, publishes, apparently in full, the official (French) document regarding the treatment in case of persons injured by electric shocks.

Electrical Industries in New York State.—The "Elec. Rev.," Nov. 6, gives some brief extracts from the government census of 1890 regarding New York industries. Concerning electric welding, it states that a company installed a 20-kw welder for making fifth wheels for heavy wagons; a weld can be made in 10 minutes which formerly required 45, and there is a saving of 38 cents after paying the 10-cent royalty; the cost of the welder is estimated as $2000. Some data is given regarding electric smelting, for which the total capacity at that time, 1890, was 69 kw; about 2000 pounds of raw material are handled per day, electricity being used for heating only; the products are aluminium and its alloys, and the alloys of silicum and manganese; the quantity of refined metal produced is 1500 pounds per day. Two central light and power stations have storage batteries, one at Coopertown, 57 cells, and another at Waterloo, 126 cells; the number of accumulator cells in isolated lighting plants in New York City is 531 and outside of the city 422; the number of incandescent lamps connected to accumulators for New York City was 911, for the rest of the State 445. The total mileage of streets over which electric cars were operated was 89.23.

Electricity in Japan.—The "West. Elec.," Nov. 2, contains a short article by Mr. Curtis. Another article on the opportunities in China and Japan, by the same author, is reprinted from the Chicago "Record" in the "Elec. Eng.," Nov. 6.

Electricity at the Paris Exposition of 1900.—The article noticed above is reprinted in the "Am. Eng.," Nov. 1.

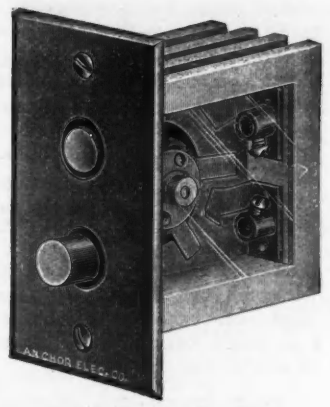
Electricity in a Shoe Factory.

A change of considerable interest to the shoe manufacturing trade is being made by the General Electric Company for a factory in Ohio, which is engaged in equipping its works throughout with electricity for the operation of its machinery. For this purpose a 75-hp moderate-speed generator driven by a belt from a steam engine has been installed, and a further provision made for a generator of about 100 hp for direct-connection to an automatic engine. The current from the generators is supplied to two motors of three hp capacity each, slow-speed type, geared direct to the shaft of the fitting room; one of 15 hp, belted directly to the line shaft in the bottoming department, and one of 20 hp, coupled directly to the dust collector. A further installation of motors will be made a little later on in the fitting room, and also in the bottoming department. Still another motor will run an additional dust collector, and two belted motors will run elevators.

This is the first step toward the adoption of electricity in shoe manufactories in that section, and it is anticipated that the economy and convenience shown in this plant will lead to its more extensive use in the operation of many old, and certainly all new, shoe factories.

A New Push-Button Flush Switch.

We illustrate herewith a new flush switch which is being placed on the market by the Anchor Electric Company, of Boston. The device is an adaptation of the Anchor Company's well-known rotary switch, and consists of the make-and-break mechanism of that switch placed in a rectangular case and arranged to be actuated by pushes instead of the usual thumb-piece. Pushing the white button puts a coiled spring under tension, and when the maximum tension is reached a cam releases the rotary contact mechanism, allowing the spring to throw it around to the "on" position; at the same time the black button is pushed out beyond the wall plate. Pushing in the black button actuates the mechanism in a similar manner, the contact, however, being thrown around so as to break the circuit, and the white button being forced out again. Owing to the fact that the rotary contact mechanism is held stationary until the full tension of the spring is attained, and then suddenly released, it moves with great force and rapidity and reduces the sparking to a minimum. The device is made in single-pole, double-pole, three- and four-point forms, of 20 amperes capacity.

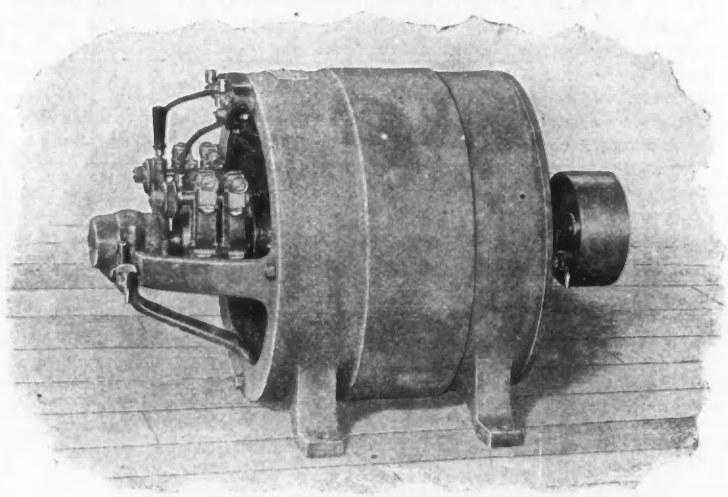


Push-Button Switch.

Ironclad Generators and Stationary Motors.

The list of slow and moderate speed four-pole dynamos and motors of the General Electric Company has been supplemented by a series of machines adapted to smaller output than is practicable with the four-pole type. They are known as "I-B" motors, from the fact of having an ironclad bi-polar frame, and are built for various outputs—from ¾ to 4½ kw as generators, and from 1 to 5 hp as motors.

The frames are cylindrical and are supported on short legs. This brings the centre of gravity very low, and conduces to stability and steadiness when running. The space occupied by the machine is small for its output, and its shape and construction allows of its use in positions where machines of the ordinary bi-polar type could not well be placed. The armature has a toothed core, with the conductors embedded in the slots. Ample cross-section has been allowed the copper in the field and armature windings, and the insulation is of the highest grade.



"I-B" Motor.

The brush holders are designed to hold the brushes firmly and evenly upon the commutator, adjusting themselves readily to the wear of commutator and brush, preserving under all conditions a good contact without excessive friction. The speeds are comparatively low, varying from 1800 to 1000 revolutions per minute, according to the size of the machines.

These motors are especially adapted to the requirements of small motor service. Their small size, low speed, high efficiency and simplicity of construction render their use convenient in printing, wood turning and establishments of a similar character, and for the operation of small pumps, ventilating fans, machine tools, etc. The generators are successfully used in isolated plants and in cases where a small amount of current economically generated is desired.

Electric Rock Drills.

Many attempts have been made from time to time to produce a direct-acting electric percussion drill, and while a certain measure of success has attended some of the efforts in this direction, yet nowhere among the accounts of the many mining installations that have recently been made is there found any mention of the electric drill. Some years ago the General Electric Company made some efforts to introduce the Marvin electric drill, and the first experience with the plants installed was quite gratifying. It soon became apparent, however, that the drill, as then constructed, was not adequate to meet the demands made upon it.

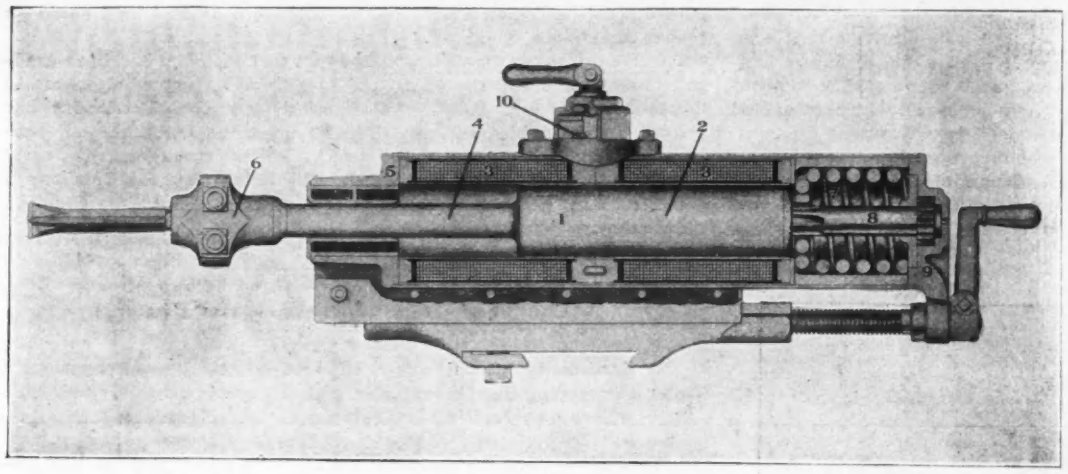


FIG. 1.—CROSS-SECTIONAL VIEW OF DRILL.

During the last three years work upon this system has been going forward, and the results obtained with the perfected apparatus have been so gratifying that the Marvin Electric Drill Company, of Syracuse, N. Y., has established a plant at Canastota, N. Y., for the manufacture of these drills and special dynamos for supplying the peculiar current required in their operation.

Extensive investigation has resulted in such an improvement in the electrical design of the drill that the efficiency has been very greatly increased, with the result that machines of a given weight can now be made that are much more powerful than those formerly built. The mechanical design of the drill has also been changed in such a way as to overcome the defects which existed in the earlier forms of drills. The principle of operation, however, remains unchanged, the Marvin system of alternately energizing two solenoids and shifting the current at the dynamo being still employed, a specially arranged dynamo for producing pulsating currents of low frequency and delivering them over two circuits, in alternation, having been designed.

By those who have followed the history of the development of the electric drill it will be remembered that the principal sources of trouble were as follows:

First: The overheating of the machines, which has been overcome by the improved electrical design of the present machines, which enable them to do satisfactory work without overcrowding and consequent overheating.

Second: It was at first considered necessary to use a plunger in which the extension from the magnet portion to the chuck was formed of brass or some non-magnetic material. This soft metal was found incapable of resisting the shock upon the drill rod in drilling hard rock. This construction has been abandoned and the plungers are now made of solid steel, with a shank of reduced diameter. These plungers are no more subject to breakage than the steel plungers of air drills.

Third: The defect due to the breakage of the cushion spring, which assists in checking the backward stroke of the plunger and imparts the energy thus stored to the forward stroke, has been obviated by changing the shape of the springs and increasing their size, and many of these new springs have now been in use for upward of three years, and none of them have ever yet been broken. Another apparently minor detail, which occasioned a great deal of annoyance, was the cable connection, by means of which the wires of the flexible cable were attached to the drill. Many different forms of switches were devised for this purpose, all of them following the "quick break" plan. It was finally discovered, however, that for the peculiar current employed in this system a form of switch was required radically different from that employed in other electric circuits, namely: A very "slow break" switch, and in the present construction the three cable wires terminate in three contact plates, which are located at the extremities of a triangle. These plates are forced down upon three similarly arranged plugs on the drill by a screw, whose line of thrust is in the centre of the triangle, thus insuring perfectly solid contact upon each of the three plugs.

With a "quick break" switch the circuit is liable to be interrupted when the current is at the top of a wave, and the interruption of the circuit at this period is attended by destructive flashing and straining of the insulation on the drill and dynamo. If, however, the current of the circuit is interrupted gradually, as by the withdrawal of a screw, the time occupied in breaking the connection between the two contact plates is so great that the wave of current is completed and the current shut off from that branch of the circuit at the dyname before the contact surfaces are separated sufficiently to produce an arc of any magnitude. In this system, each circuit is energized only half of the time, a period of idleness following a period of activity. By the use of this switch the circuit is always interrupted without flashing or straining of insulation, and the form of the switch or connection is made extremely simple.

When the electric drill was originally put out every expedient was resorted to to obtain the low-period pulsating current required for their operation, and the required currents were usually secured by slowing down the speed of a standard power generator to the required number of revolutions per minute—about 350—or by revolving a pair of carbon brushes slowly around the ordinary commutator of a continuous-current dynamo. The first of these methods resulted in seriously reducing the output of the dynamo, while the second involved a more or less complicated mechanical arrangement of the dynamo which was not well adapted for mining purposes. A dynamo has now been designed by the Marvin Company, with a view to supplying directly the low-period pulsations required. This machine runs at the slow speed required by the drills, making from 350 to 400 revolutions per minute, as is required. The armature is of large diameter, and the winding extremely simple. The field coils surround the armature, and the field and armature are both made up from sheet iron punchings, the armature disc being punched from the centre of an oblong sheet of iron, the punching forming one element of the armature, while the remainder of the sheet forms one element of the field. The armature winding is carried through holes

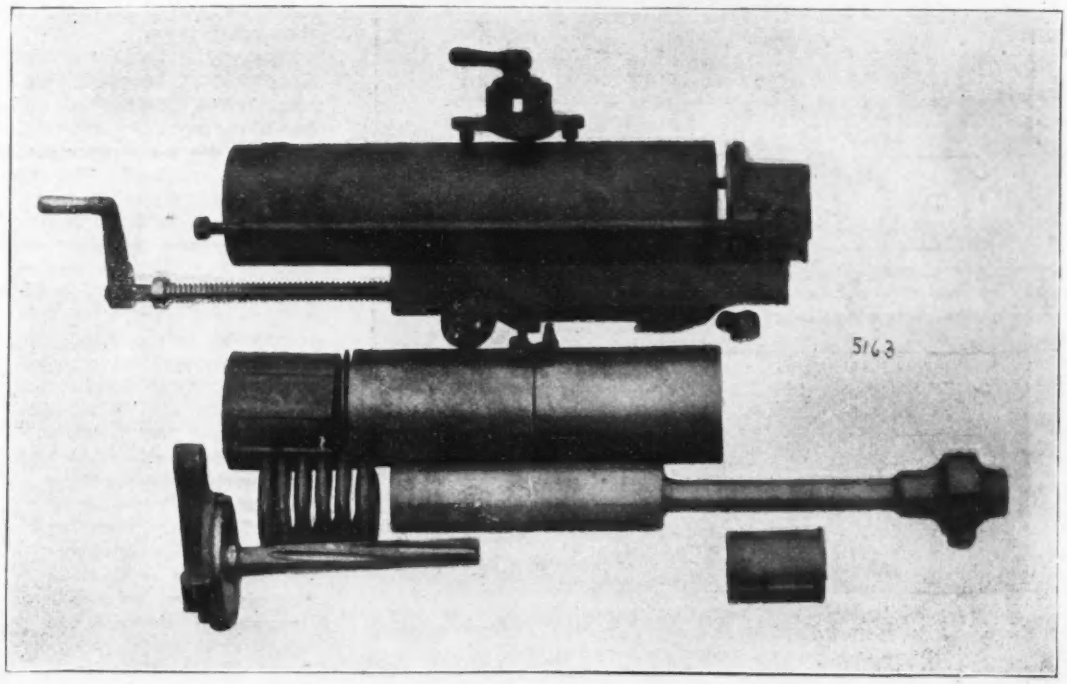


FIG. 2.—SOLENOID DRILL DISMANTLED.

near the periphery of the armature, and the wires do not cross at the ends, being carried across the ends in parallel lines, the winding being a modified form of the old Siemens' shuttle winding.

The collector ring is located between the armature and bearing, while the split ring commutator, which directs the current in alternation over the circuit, is located outside of the bearing on the end of the shaft. This commutator is held in place and connected to one terminal of the armature winding by a single bolt, and can be removed or replaced in the space of a few seconds. The other end of the armature winding is connected to the collector ring inside of the bearing. The winding of the armature is so simple that an ordinary mechanic can rewind it in the space of a few hours, a flexible conductor being used and the holes through the armature being insulated with mica tubes.

The machine can be readily subdivided into small parts where it is required to transport the machinery on mule back, as the armature and field can be assembled at the mine, as well as at the shop. Tests with this machine show a higher efficiency than is obtained with continuous current machines of standard design, equipped with revolving brushes, and there is no comparison in the simplicity of construction.

A brief description of the plant at the quarries of the Solvay Process Company, of Syracuse, N. Y., will show the practicable character of the electric drills as they are now manufactured.

Drills of the modern type have been in operation at this plant for over

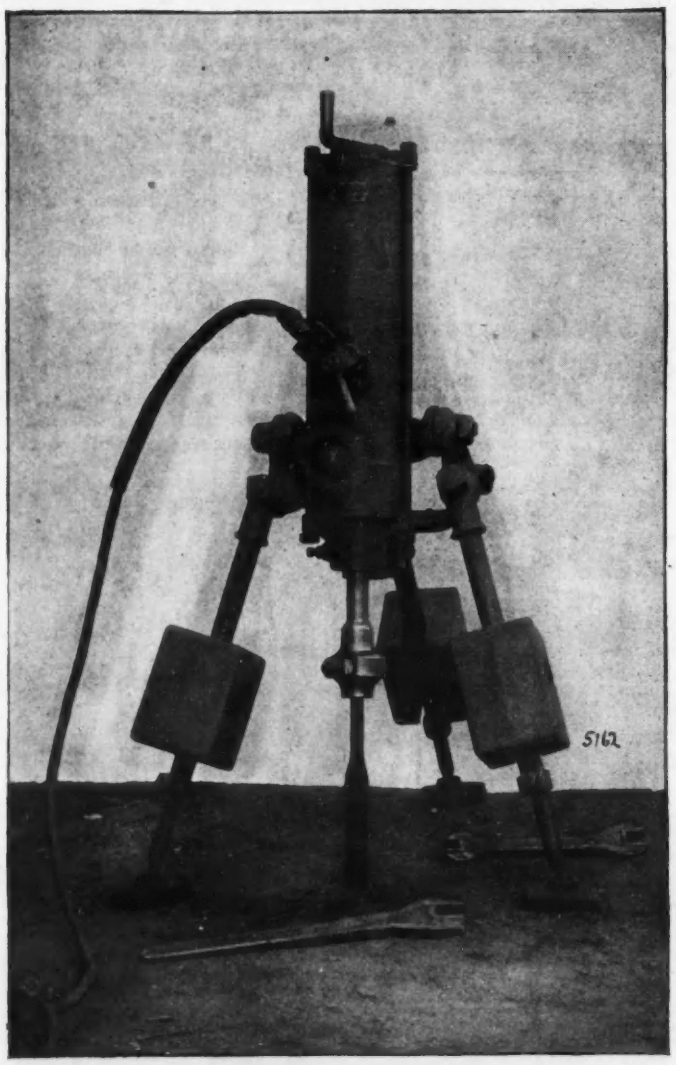


Fig. 3.—Drill and Tripod Complete.

two years with the greatest success, but the manufacturers have refrained from again entering the market with these drills until their entire reliability had been demonstrated by several years of experience. The Solvay quarries are quite extensive, extending over an area of upward of a mile in length by half a mile in width. The power plant is located in a ravine about 125 feet below the lower level of the quarry. From this power building four lines or feeders extend to the different parts of the quarry, all joining onto a back line, which runs the entire length of the workings. Bare copper wire is used in line construction. From the back line wires are led over portable poles to the different parts of the quarry where it is desired to drill, and connection is made to the drill by means of 100 feet of flexible cables. Seven drills are now in use at this quarry, and more are being made for them. Four of these drills are of the large or seven-inch type, and are used in drilling holes two and one half inches in diameter and from six to eight feet in depth. Three small five-inch drills are used for block holing and plug and feather work. A careful record is kept by the Solvay Company of the daily performance of each of the drills, so that it is possible to determine exactly what work they have done.

This plant was started with three drills, in January, 1893, and the records show that the average performance of each drill during the entire period since that time has been over 68 feet per day of 10 hours, including all the time lost in moving and shifting the machine. Taking the record of an individual drill, it appears that a single machine in the space of two years cut over six miles of two and one-half inch holes. The character of the rock is hard blue and gray limestone, and the broken and seamy nature of the formation makes the drilling more difficult than would be the case in a more solid rock.

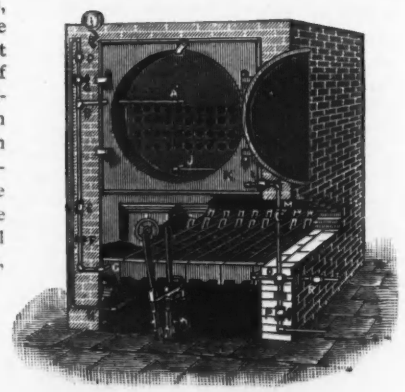
This record, taken together with the fact that the plant has been gradually increased since the start and is still being extended, seems to demonstrate beyond question that in this case the electric drill has proved an unqualified success. Repairs upon the drill have been comparatively small, and none of the defects which characterized the early type of drills have thus far developed. The Solvay Process Company is satisfied that it gets better results from the electric plant than could be obtained with air or steam.

A Combined Grate and Feed-Water Heater.

The importance of maintaining the proper thickness of fire under a boiler and keeping the fire supplied with an ample quantity of air from below, without opening the furnace doors to "slice," has long been appreciated, as the numerous efforts to produce a successful shaking grate amply testify. That the necessity has also long been recognized for protecting, in a measure, the grate bars from the heat of the fire is shown by the practice of keeping an inch or two of water in the ash-pit; and the value of feeding hot water to a boiler requires no mention of methods or instances. The combination of all three of these features in one device exists in the shape of the Reagan grate, manufactured by the Water-Circulating Grate Company, 1026 Filbert Street, Philadelphia, and illustrated by the accompanying engraving.

The grate consists of a number of extra heavy two-inch pipes, running parallel with the length of the boilers and connected at the ends by water boxes, which take the place of ordinary return-bends and connect the piping in series, so to speak, as is the case with a familiar type of steam radiator. The water tubes are supported at the centre by a bridge bar having toothed projections to prevent the loss of coal between the front and back sections.

Between the pipes are located devices designated as choppers, the function of which is to dislodge the ashes. The choppers normally present a comparatively level surface and this surface is below the level upper surface of the pipes, so that if a board were laid across the grate it would rest upon the water tubes entirely, leaving channels between the pipes for the reception of ashes. The choppers are mounted on rocking bars and are divided into two sets, one set being in front of the bridge bar and the other set back of it. The two sets of choppers are worked independently of each other by levers in front of the boiler, as shown in the engraving, this arrangement being necessitated by the fact that the coal burns more rapidly near the bridge wall than at the front of the fire, and therefore the rear choppers have to be operated more frequently than the front ones. The choppers are slotted so as to allow the passage of an ample quantity of air from the ash-pit up to the fire.



Water Grate.

The piping of the grate is connected at one end with the boiler feed inlet and at the other end with the source of water supply, and it thus performs the function of a feed-water heater. The claims made for this arrangement by the inventor are that the flow of water through the tubes protects the grate by taking up the heat that would otherwise destroy the choppers and pipes, and also keeps the boiler free from scale by reason of the rapid circulation.

The illustration shows the shaking levers located in the centre of the boiler front, which disposition is all right when the ash-pit is provided with two doors; when, however, only one ash-pit door is used the levers can be placed on either side of the door out of the way. A comparatively slight motion of the choppers is sufficient to remove the ashes so that holes are not dug through the live coal and the fire unnecessarily broken up.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 9, 1895.

ELECTRIC STOCKS were less active this week than ever, if possible, the interrupting holidays and general downward tendency of the industrials contributing largely to this condition.

ERIE TELEGRAPH & TELEPHONE has declared a quarterly dividend of 1 per cent., payable Nov. 18. The company's report for the three months ended Sept. 30 shows a gain of 867 subscribers over the preceding quarter, and a surplus of $21,671.36 for the period indicated.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96½	97
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35¾	33¼
Electric Storage, pref	100	36¼	36¾
General Electric	100	30	30¼
General Electric, pref	100	62	64
Westinghouse Consolidated, com	50	33½	33¾
" " pref	50	55	55½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	199	199½
American District Telegraph	100	35	40
American Telegraph & Cable	100	94½	98
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	60	..
Gold & Stock Telegraph	100	105	..
New England Telephone	100	87	87½
Postal Telegraph-Cable	100	..	..
Western Union Telegraph	100	80¾	80⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¾	18
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11	14
" " pref	100	..	61
Buffalo St. Ry	100	83	85
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	55	57
Consolidated Traction of N. J	..	25	..
Electric Traction, Philadelphia	50	..	63½
Hestonville	100	50	..
Long Island Traction, all pd	100	18½	19
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	17	19
" " pref	100	68	70
North Shore Traction	100	33	35
" " pref	100	84	86
People's Traction $30 pd	25	56¼	56½
Philadelphia Traction	50	71¾	72½
Rochester St. Ry	..	34	37
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	16¼	16¾
West End, Boston	100	66¾	67
" " pref	100	89	90
Worcester Traction	100	16	18
" " pref	100	87	89

BONDS.

Buffalo St. Ry. 1st con. 5s	100	108	110
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	100	102
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

THE SOUTHERN NEW ENGLAND TELEPHONE COMPANY is about to issue $150,000 of new stock which present stockholders will be allowed to take at par, one share for each ten now held. This will make the capital stock $1,650,000. It is understood that the money will go into improvements. The Southern New England is giving now, as a rule, an excellent service, and the stockholders, after waiting a good while, are getting a comfortable return for their investment. The last quarterly dividend was 1½ per cent.

THE TRACTIONS.—The sharp break and continued weakness in the securities of the Buffalo Railway Company has been the feature of the traction market this week. Large offering of stock have been made from Buffalo and the price has declined to about 80, while the consols can now be bought at about 105½ and interest. The new Buffalo Traction Company, which will be a competitor of the old road, is responsible for the decline. The proposed route of this road, as indicated in the articles of incorporation, includes some of the streets now occupied by the Buffalo Railway Company, which has the exclusive right to them with the exception that any new company may run its cars over 1000 feet of its track on any street.

BROOKLYN TRACTION is about the only exception to the general weakness of the list. The report that an agreement had at last been reached between the interests representing this company and the Nassau road regarding the leasing of the former by the latter is responsible for the advance. The most generally accepted rumor credits the Nassau Company with guaranteeing the fixed charges of the Traction Company, amounting to about $300,000, and a dividend of 5 per cent. on the preferred stock and 1 per cent. on the common. This consolidation if brought about would doubtless affect very seriously the traffic on the various roads running to Coney Island, on which the fare is more than double the proposed charge of 5 cents on the cars of the consolidated roads.

BROOKLYN CITY RAILWAY stock continues weak. The enlarged system of transfers which the company recently inaugurated is said not to have proved as remunerative as was expected. The rest of the list has been weak and dull.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 11, 1895.

AN EXTENSIVE SCHEME.—Emerson, McMillan & Co., 40 Wall Street, have just consummated the purchase of the gas works at Asbury Park, Long Branch and Red Bank, N. J., and have organized a company under the title of the Consolidated Gas Company of New Jersey, to take over the above-named properties. The new company owns franchises for electric lighting along the Jersey coast, from Seabright as far south as Sea Girt, embracing more than 30 townships, boroughs and villages. It is the purpose of the company to at once begin work on a comprehensive system of extensions and improvements.

THE BALL & WOOD COMPANY, 15 Cortlandt Street, is nearly snowed under, but by running 24 hours a day and utilizing every square inch of factory floor space, and every machine tool to the best advantage, the company manages to keep within reasonable distance of its latest orders. A feature which goes far toward smoothing out matters is the fact that the old users of Ball & Wood engines are so absolutely wedded to them that they are willing to wait for repeat orders to be filled, and this example has a salutary effect upon new customers. The company is just now sending engines to New Orleans for the St. Charles Hotel Company and the Hotel Grunewald, and to Charlotte, La., for the Delta Construction Company.

THE E. S. GREELEY & CO., 5 and 7 Dey Street, continues to push ahead in an unostentatious but none the less effective way, and a pedestrian accustomed to pass through Dey Street would feel the lack of a landmark if he should at any time fail to see one or more large wagons loading or unloading vast quantities of goods at this widely-known store. The company has recently issued another edition of its encyclopædic catalogue of electrical supplies, containing almost everything in practical use to-day. The energetic business policy of the house, its uniformly courteous treatment of customers and the reliability of its goods have combined to build up an enormous volume o trade to which all the enlightened countries of the world contribute.

THE ELECTRIC STORAGE BATTERY COMPANY, through its New York office, has recently closed a contract for a complete electric lighting plant for Mr. Frank Thomson, Merion, a vice-president of the Pennsylvania Railway Company. The plant consists of a 25-hp Otto gasoline engine, belted to a 20-kw multipolar dynamo, and a Chloride accumulator plant consisting of 60 elements of type "11-G" in lead-lined tanks. These cells have a capacity of 1000 ampere-hours at a 10-hour discharge rate, but provision is made in the tanks to double the number of plates, thereby increasing the capacity to 2000 ampere-hours. The power-house in which is the storage battery room, is situated about 300 yards away from the residence, the current being conveyed by a cable of 300,000 circular mils, run partly on poles and partly underground. The power-house has been specially designed and built for this plant, and the whole installation will be as complete as it is possible to make it. The company has also closed a contract through Zimdars & Hunt for a battery of Chloride accumulators for the yacht *Intrepid* of the New York Yacht Club.

THE NASSAU-BROOKLYN TRACTION DEAL is said to have been brought to a mutually satisfactory basis. It is stated that the Nassau Company has agreed to the Traction Company's terms, and a lease in accordance with these terms is now being drawn up, which the stockholders of the companies will formally ratify in a day or two. When the deal is formally closed the two roads will be operated as one. There will be no extra fare charged. A uniform rate of five cents will be charged to all sections of Brooklyn. Connections will be made between the various lines of the two companies as soon as possible. Direct routes will be made between all the ferries and the bridge to the terminals of the Nassau lines at the West End, Brighton, Manhattan, Fort Hamilton and Canarsie. Where through cars are not operated transfer stations will be established, and as soon as travel warrants through cars they will be run. The capital of the Brooklyn Traction Company is $6,000,000 common stock, $3,000,000 6 per cent. preferred stock. It controls the Atlantic Avenue system, with 42 miles of tracks, and the Brooklyn, Bath & West End Railway, with 13 miles of tracks. It is reported that the Nassau Company is to pay the Atlantic Avenue Company a rental of $290,000 annually, 4½ or 5 per cent. on its preferred stock and 1½ on the common stock, and will also spend $500,000 in improving the Atlantic Avenue roads, and surrender them back with all the improvements in case it defaults in the payment of rental or dividends.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Nov. 9 1895.

AUGUST BECKER, 55 Oliver Street, an expert designer and engraver of steel, brass and bronze plates, etc., is making a specialty of name plates for dynamos, motors, and all other kinds of machinery. A crude name-plate is a decided "black-eye" to any piece of electrical apparatus, and the fact that Mr. Becker is cognizant of the necessity for tasteful and highly finished work is worth remembering. He has had many years experience in this class of work, and has excellent facilities for the production of the best results.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Nov. 8, 1895.

THE AMERICAN FUSE COMPANY, of 87 Washington Street, is having quite a run with its "Solid Joint" coupling. A test made last week with one of these devices resulted in the breaking of the wire outside the joint, which remained apparently as strong as before. The joint sustained a strain of 450 pounds without showing any sign of weakness, and it was at this point that the wire parted. Those who witnessed the test were enthusiastic in their commendation of the device, and it was the unanimous opinion that the joint would have borne 1000 pounds strain had not the wire given way.

A NEW LINE SECTION AUTOMATIC CIRCUIT-BREAKER has been perfected by the Automatic Circuit-Breaker Company, 937 Monadnock Building, for use on street railway lines. The device is enclosed in a neat waterproof box, and is hung on the pole near the cross-arm, where each section of the line branches off from the main trunk line. In case of a short circuit, ground, or any accident causing a sudden overload, the circuit-breaker will at once open, cutting off only the injured section and leaving the rest of the line in running order. After the trouble is removed the circuit-breaker can be closed and the section restored.

Canadian Notes.

Ottawa, Nov. 8, 1895.

EGANVILLE, ONT.—The electric light plant which is being placed in this town by Ahearn & Soper will be in operation in two weeks.

ALEXANDRIA, ONT.—The contract for an electric light plant and for wiring the streets has been awarded by the Village Council to Ahearn & Soper, of Ottawa.

PORT TERRY, ONT.—A scheme is on foot to construct an electric railway from Kincardine to this town. Curts has raised the sum of $500 to pay surveying expenses.

HALIFAX, N. S.—It is understood that the Halifax Electric Tramway Company has decided not to build and operate the northwest branch of the electric road this Fall.

JOLIETTE, QUE.—The Chamber of Commerce here is discussing the project of an electric railway between this town and Lanoraie, to connect with the St. Lawrence navigation.

HUNTSVILLE, ONT.—Mr. V. M. Roberts, C. E., of St. Catherines, has made a survey of the town with a view of establishing a system of electric lights. The cost would be about $10,000.

TOWNSHIP OF BERTIE.—The Crystal Branch Cottage & Improvement Company has received a charter, which, among other things, empowers it to construct and operate an electric light plant.

LONDON, ONT.—This city will shortly see the electric street railway inaugurated. Halifax, that "slow coach," old conservative town, the capital of Nova Scotia, is the last of the cities of Canada to talk electric street railway.

FORT WILLIAM, ONT.—The company that recently acquired the Kakabeka waterworks is negotiating with this town for the putting in of an electric light plant, and it is probable the offer of the company will be accepted.

CHATHAM, ONT.—The electric railway projectors have made a survey of the town, and pronounce the prospects good. They will invest $150,000 in the enterprise, and will build a loop line in the city, and give a six-minute service.

MILLBROOKE, ONT.—The Millbrooke Electric Light Company is applying to the Ontario Legislature for a charter. J. C. Kells, Wm. Vance, R. J. Doak, W. T. Wood, all of Millbrooke, and S. G. Parker, of Lindsay, are the first directors.

HAMILTON, ONT.—The Hamilton, Grimsley & Beamsville Electric Railway has just completed its first year with a record of 220,894 passengers and 15,042 tons of freight. At present the road only runs to Grimsley, a distance of 18 miles. It will be completed next year.

ST. CATHERINES, ONT.—The City Council has passed a resolution asking the Government to grant letters-patent to the Lincoln Street Railway Traction & Light Company. Wm. Wilson, George Palmer, R. H. Hill, H. A. King George E. Patterson and Dr. Oille are the parties interested.

NEWMARKET, ONT.—H. S. Cane, of this town, is looking for a purchaser for an electric light plant, arc and incandescent. There is a ten years' contract for lighting the town of Newmarket with at least 21 arc lights. There are now 450 incandescent lights installed, with lots of room for extending the business. ——The electric light inspection which the government is enforcing appears to be meeting with the wishes of the people. In cities and towns where meters are used the government has provided apparatus for testing them, and in smaller places when only the question of the power which the companies are carrying will be in dispute, portable test meters are used to find out if the company is supplying enough electricity to give the required candle-power, or if too much, thereby endangering the burning out of lamps.

OTTAWA, ONT.—A member of the Dominion Government stated to-day that he had no doubt the several colonies interested, with the co-operation of the British Government, would construct the projected Pacific cable from British Columbia to Australia. A conference would shortly be held in London for the purpose of looking into the probable cost and the extent to which Canada and the other British possessions would have to contribute to insure the undertaking.——Owing to the many marine disasters which have taken place along the St. Lawrence and Labrador coast the Canadian Board of Underwriters has stated that unless the government extends its telegraph system to the Straits of Belle Isle there will have to be a general increase in marine risks. The past season has been very severe on marine insurance companies and it is often several days after it happened before word of a wreck reaches the insurance people, when immediate notification might have saved the wrecked vessel.

TORONTO, ONT.—It is stated that the object of the Canadian Electric Railway & Power Company, of Toronto, which will ask for a charter next session, is to take advantage of an alleged invention of Nikola Tesla, by which it is claimed electricity can be transmitted for 200 miles in both directions. Mr. Bristol, who is acting for the promoters, says that if the invention is feasible the proposed line of the company could be operated by two power houses, one on the Trent River and the other at Suspension Bridge.——After running for 15 years the Grand Trunk Mimico suburban railway train has been discontinued. This is due to the successful competition of the Long Branch electric car service, which, of late, has almost entirely monopolized the passenger traffic.——A. J. Mullholland, J. Lockhart, J. M. and N. Garland and W. Delaney, all of Toronto, have, under the name of the Northumberland Paper & Electric Company, secured a charter from the Ontario Government for the purpose of supplying electricity for light, heat and power.

MONTREAL, QUE.—The annual statement of the Montreal Electric Street Railway places the gross earnings at $1,101,204 and the net earnings at $443,392, or a dividend of 10½ per cent. on paid-up capital. The operating expenses are placed at 59.74 per cent.——A Quebec religious paper prints the following extract from the records of the proceedings of the Sacred Congregation of Rites, Rome, June 4, 1895: "Question. May electric light be used in church? Answer. For purposes of worship, no; but for dispelling darkness and more brilliantly illuminating the church, yes; but care must be taken that the manner of illuminating shall not resemble a theatrical spectacle."——The annual meeting of the Montreal Street Railway was held this week. The president stated that owing to the inability of the company to secure cars in the city it had been found necessary to purchase a number in Toronto and Ottawa. In future, however, the cars would be built in the company's own shop in Montreal ——The Montreal & St. Lambert Bridge & Electric Railway Company is making application to the Dominion Parliament for a charter to contruct a railway and highway bridge across the St. Lawrence River at Montreal. Power is also asked to construct and operate electric railways from the terminal of the bridge to the eastern boundary to the County of Chambly and the western boundary of the County of Laprairie.

English Notes.

[FROM OUR OWN CORRESPONDENT.]

London, Oct. 30, 1895.

THE THOMSON-HOUSTON LINE recently opened at Bristol is already proving a sort of Mecca to municipalities contemplating the adoption of a mechanical system of traction. A day or two ago the line was visited in state by the members of the Corporation, who were very much pleased with all they saw.

ELECTRIC COOKING.—Electric lighting concerns, especially municipal ones, continue to leave no stone unturned in the direction of promoting a steady day load. To this end electric cooking is being actively pushed. At Dewsbury the Town Council recently inaugurated an exhibition of the capabilities of electricity in this direction, and at Huddersfield the charge for electric energy for this purpose has been reduced to 2½d per kw-hour, at which price electric heating ought to compete very favorably with gas.

WESTINGHOUSE ELECTROMAGNETIC SYSTEM OF TRACTION.—A press view was held of the new Westinghouse electromagnetic system of traction on Friday last. It is evidently the intention of that company to push this system in this country as well as in the United States. In this connection I may mention that there are many signs that the ice has at last been broken and we shall shortly be witnessing in this country a development of electric traction comparable, considering the small extent of our tramway system, to the development which has taken place during the last five years in America. Permission has just been granted to equip a section of the Birmingham Central Tramway Company's system on the overhead trolley plan. The proposal to

equip Newcastle with cable trams is being fiercely opposed. An electric light railway scheme is being actively pushed in Derbyshire, and all over the country the town councils and the general public seem to be at last awakening to the fact that there is a more suitable mode of tramway haulage than that afforded by horses, and when we do awake to realities of this kind we make some amends for our tardiness by going to work in a thoroughly workmanlike manner.

ELECTRIC LIGHTING OF EDINBURGH.—At a meeting of the Institution of Mechanical Engineers last Wednesday, Mr. H. R. Burstall read an interesting paper describing the system of electric lighting inaugurated about six months ago in Edinburgh. This system has been carried out according to designs of Prof. A. B. W. Kennedy. There are several special features in the electrical and mechanical equipment. In the first place the area lighted is divided into two distinct sections, the one supplied with continuous-current on three-wire low-pressure system, the other with alternate-current on the high-pressure transformer system. In addition, public lighting is carried out by street arc lamps, some of which are run in series off Ferranti rectifiers, others being placed in parallel on the low-pressure mains. Within the station one of the most interesting features is the use of superheaters. These are arranged to derive heat from the furnace gases when these are at a temperature of about 800 degrees Fahr. Many of the speakers in the discussion which took place questioned the advantage of placing superheaters in such a cold part of the furnace, but there was a general consensus of opinion in favor of superheating for central stations.

EFFICIENCY OF ROPE AND BELT TRANSMISSION.—On the following evening the Institution of Mechanical Engineers took Prof. Capper's translated report on the experiments which were conducted some time ago at Lille with a view to determining the relative efficiency of ropes and belts for the transmission of power. These experiments were carried out under the auspices of the Societie Industrielle du Nord de la France, Prof. Capper being the delegate from the Institution of Mechanical Engineers. The experiments lasted for three days, but practically nothing of real utility resulted, and in the discussion which took place last Thursday the general feeling seemed to be that a good opportunity for clearing up some of the doubts about the efficiency of these forms of gearing was thrown away. Several of the speakers recommended that a modification of the two-dynamo method should be used for carrying out trials of this sort, two similar dynamos being geared together, one running as a generator, the other as a motor; measurements of the electrical power supplied and taken off would enable the loss of power in the gearing to be determined much more accurately than by taking indicator diagrams of steam engines or gas engines. Mr. Crompton amused every one by the confidence with which he predicted that in a short time such considerations as the efficiency of rope and belt gearing would be unnecessary, since ropes, belts, pulleys and all such things would be relegated to the museums and electromotors would take their place.

General News.

NEW INCORPORATIONS.

THE DUNMORE STREET RAILWAY COMPANY, Scranton, Pa., has been organized by Frank Silliman, Jr., Horace E. Hand and Robert F. Fox, Scranton, Pa., to build an electric street railway. Capital stock, $30,000.

THE CAMDEN WATER, LIGHT & POWER COMPANY, St. Louis, Mo., capital stock $50,000, has been formed to furnish electric light and power, by F. W. Paramore, E. E. Paramore, H. F. Mueller and Charles Brown, St. Louis, Mo.

THE OHIO VALLEY ELECTRIC RAILWAY COMPANY, Pittsburg, Pa., capital stock $25,000 has been incorporated by William T. Lindsay and Henry E. Lineaweaver, of Pittsburg, and Edgar C. Gerwig, Allegheny, to build a railway in Allegheny county.

THE OAKDALE ELECTRIC LIGHT, HEAT & POWER COMPANY, Oakdale, Pa., capital stock $8000, has been formed to supply electric light, heat and power. The promoters are John C. Bryson, Samuel E. McClurg, and Samuel D. Bryson, Oakdale, Pa.

THE SMITH-VASSAR TELEPHONE COMPANY, New York City, N. Y., capital stock $1,000,000, has been incorporated to make and sell electrical devices, etc. The promotors are W. L. Beardsley, F. T. Winston, J. T. Darling and A. N. Hand, New York City.

THE DANSVILLE GAS & ELECTRIC LIGHT COMPANY, Dansville, N. Y., has been organized by W. T. Spinning, W. A. Spinning, D. A. Batterson, C. H. Bowe, of Dansville, N. Y., to manufacture and supply gas and electricity. Capital stock $25,000.

THE EVANSTON ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $200,000, has been organized by Andrew Crawford, Thomas C. Milsted and Parke E. Simmons, to acquire, maintain, and operate horse, dummy and electric street railways.

THE KEY WEST ELECTRIC LIGHT & POWER COMPANY, Key West, Fla., has been formed to operate and maintain electric lights and power. The promoters are Charles Curry, M. L. Kellings, M. W. Curry and Joseph Y. Porter, Key West, Fla. Capital stock, $25,000.

THE MARYSVILLE ELECTRIC LIGHT & WATER COMPANY, Marysville, Mont., capital stock $50,000, has been formed for the purpose of manufacturing, generating and dealing in electricity. The promoters are George Berg, Charles C. Wenstrom and John Edgerton.

THE MONROE CITY ELECTRIC LIGHT & POWER COMPANY, Monroe City, Mo., capital stock $10,000, has been organized to furnish electric light and motive power, by William Wood, West Hartford, Mo., E. P. Nelson, Monroe City, Mo., and M. T. Raglund, Monroe City, Mo.

THE REED ELECTRIC COMPANY, Philadelphia, Pa., capital stock, $500,000, has been formed by Amos W. Bacon and Carl Hering, Philadelphia, Pa., and Marcellus T. Morrill, Camden, N. J., for the purpose of manufacturing electrical and mechanical apparatus and appliances.

THE BUFFALO TRACTION COMPANY, Buffalo, N. Y., capital stock $3,000,000, has been incorporated to build and operate an electric street railway. Those interested are E. C. S. Miller, J. B. Mayer, Buffalo, N. Y.; T. L. Johnson, Cleveland, O., and J. K. Page, New York City, N. Y.

WADDELL-ENTZ MACHINE COMPANY, New York, N. Y., has been incorporated to buy and sell electrical apparatus and machinery. Those interested are Alfred A. Whitman, and Antonio Knauth, New York City, and Jose A. Machado, Plainfield, N. J. Capital stock, minimum, $250; maximum, $50,000.

THE NEWTON TRACTION COMPANY, Jersey City, N. J., has been formed to contract for, and construct electric railways and electric light and power plants. Those interested are Horace B. Parker, Newton, Mass.; Louis Pfingst, Boston, Mass.; Frank Hillyer, New York City; John N. Baldwin, Council Bluffs, Ia. Capital stock $1,000,000.

THE STANDARD ELECTRIC STORAGE BATTERY COMPANY, New York, N. Y., has been formed for the purpose of manufacturing, leasing and selling electrical appliances, batteries, etc. The promoters are Ernest Thalman, B. T. McDonald, James Marwick, W. H. Bankier, New York City, N. Y. Minimum capital stock $1000. Maximum $5,000,000.

THE UNION POWER COMPANY, Cleveland, Ohio, has been organized for the purpose of generating and distributing from one or more centres, electric or other power for electro-chemical, welding, heating and other purposes. The promotors are H. N. Chamberlain, J. Henry White, F. C. Phillips, George C. Wing and Morris S. Towson. Capital stock $50,000.

THE CLEAR LAKE ELECTRIC POWER COMPANY, Lakeport, Cal., capital stock $2,000,000, has been incorporated for the purpose of constructing electric power plants and irrigation works for power purposes. The promoters are E. P. Clendenin, D. C. Rumsey, Lakeport, Cal.; J. K. Fraser, Kelseyville, Cal.; C. E. Moore, San Francisco, and Richard Wylie, Napa, Cal.

THE MOUNT LOWE RAILWAY COMPANY, Pasadena, Cal., has been formed to construct, lease and operate electric and other railways, operate telephone and telegraph lines, water, electric lighting and power plants. The incorporators are Thaddeus S. C. Lowe, Leon P. Lowe, Herbert C. Brown, Sobieski Lowe, Pasadena, Cal., and Thaddeus Lowe, Altadena, Cal. Capital stock, $1,000,000.

THE LIMA & PIQUA ELECTRIC STREET RAILWAY COMPANY, St. Mary's, O., has been organized to build and operate a street railway between Lima and Piqua, to be operated by steam, horse, electric or other motive power; also to furnish light, heat and power. The incorporators are B. C. Faurot, D. W. Jay, D. Armstrong, William H. Hartman, S. McFarland and Edward Burns. Capital stock $9000.

THE OSBORN ELECTROMAGNETIC RAILWAY SYSTEM, Auburn, N. Y., has been incorporated in West Virginia with a minimum capital stock of $30,000, and a maximum capital stock of $1,000,000, for the purpose of manufacturing apparatus for transmitting electro-motor cars, and all appliances pertaining to electric railway equipment. The incorporators are Byron E. Osborn, J. Harrison Pearson, Ruth E. Osborn, Auburn, N. Y.; Charles Thompson, New York City; A. J. Parker, Auburn, N. Y.

ELECTRIC LIGHT AND POWER.

MOWEAQUA, ILL.—Moweaqua is discussing the question of electric lighting.

SHARON HILL, PA.—A contract will soon be let for lighting the borough by electricity.

ATLANTA, IND.—Atlanta will organize a local company and light the town with electricity

LITTLE VALLEY, N. Y.—It is proposed to bond the town for $7000 for municipal electric lights.

HUBBARD, O.—The Council passed an ordinance providing for the issue of $6000 electric light bonds.

PLYMOUTH, MICH.—Local capitalists are considering the plan of building an electric lighting plant in this place.

CATAWISSA, PA.—By a vote of 307 to 59, the citizens of the borough voted in favor of a municipal electric light plant.

CLEVELAND, O.—The Hafemeister Electric & Machine Company will manufacture machinery and electric goods.

NIAGARA FALLS, N. Y.—The Cliff Paper Company, of Niagara Falls, has decided to adopt electricity as a motive power.

TOLUCA, MEX.—It is proposed to introduce electric lighting in Toluca, capital of the State of Mexico, utilizing neighboring waterfalls.

UPLAND, PA.—Proposals for lighting the streets of the borough of Upland will be received by the borough Council until 4 p. m., Nov. 4.

KANSAS CITY, MO.—Alderman Wine has introduced an ordinance providing for putting all telegraph and electric wires underground.

CORUNNA, MICH.—At a recent special election Corunna decided to issue bonds for $30,000, to put in waterworks and an electric light plant.

TRENTON, N. J.—Mr. Rothschild, who is to establish a shirt factory in Rahway, will probably introduce electric motors to run the sewing machines.

HENDERSON, KY.—The citizens have decided, by a vote of 723 to 72, to put in an electric light plant, the cost of which is estimated at $40,000 to $50,000.

GLOVERSVILLE, N. Y.—The village authorities have contracted with the Saratoga Gas & Electric Light Company for street lights at $99.90 per annum for each arc lamp.

ONTONAGON, MICH.—At a special election held for the purpose, the citizens voted to bond the village for $12,000 for the purpose of putting in an electric light system.

PHILADELPHIA, PA.—Work will be begun in a short time upon the renovation of St. Augustine's Roman Catholic Church. Electric light fixtures and wiring will be put in.

EAST ORANGE, N. J.—The Suburban Electric Light & Power Company has asked permission to place conduits for underground wires for the transmission of electricity.

LAFAYETTE, LA.—Proposals are wanted until Nov. 20 for surveys, maps and estimates for waterworks and electric light plant. T. M. Biossat can furnish detailed information.

DURAND, MICH.—By an almost unanimous vote the citizens decided to install their own electric light plant. Work will be begun at once, and the plant will be running by Jan. 1.

BERKELEY, CAL.—The Board of Trustees, on Oct. 25, decided to advertise for bids to be received at the next meeting, for placing incandescent lights on the streets of Berkeley.

ALLENTOWN, PA.—Philip Schneider, shoe manufacturer, will build a factory, 60 x 100, on Jefferson and Pine Streets. The motive power of the new factory will in all probability be electricity.

WILKINSBURG, PA.—Sealed proposals will be received by the Borough Clerk until 12 m. Nov. 16, for the furnishing and operating sixty-five arc lamps of 2000-cp, to be located as Council may direct.

ROCKVILLE CENTRE, L. I., N. Y.—Arturo Gercie & Co., 138 Front Street, New York City, are seeking a franchise from the village trustees, and will agree to put in an electric light plant to cost $50,000.

BENTON HARBOR, MICH.—At the regular meeting of the Council, Oct. 25, the committee on ways and means recommended that the city put in an electric light system, in connection with a waterworks plant.

FLUSHING, L. I., N. Y.—At an adjourned meeting of the Board of Trustees of the village, application was received from the Long Island Electric Company for a franchise to establish an electric light plant in the village.

WASHINGTON, D. C.—The Potomac Electric Light & Power Company has secured the contract to light Tennallytown by electricity, and will immediately string wires and erect electric lamps in place of the naphtha lamps now in use.

TAMPA, FLA.—It is said that the electric light, telegraph and telephone companies will combine and fight the ordinance recently enacted by the Council which imposes a tax of 25 cents per annum on each pole in the city used by these companies.

TRENTON, MO.—J. C. Lason, who recently traded for the electric light plant, has sold the plant to Hazon & Campbell. It is the intention of the new owners to put the plant in good condition at once. They will put in new boilers and other machinery.

BEATRICE, NEB.—The Beatrice Light & Power Company and the Beatrice Rapid Transit Company have been consolidated under the name of the Beatrice Electric Company, with a capital stock of $100,000. Extensions and improvements will be made immediately.

CHESTER, PA.—Engineers are investigating the waters of the Susquehanna River, with a view to the erection of the Susquehanna River Electric Company's works at Conowingo. The company will supply light, heat and power to Baltimore, Wilmington and other places.

ROME, N. Y.—Plans and specifications may be seen and forms of proposals obtained at the Rome State Custodial Asylum, for furnishing and installing an electric lighting plant for the asylum. Sealed proposals may be sent by mail or delivered in person, up to 12 m, November 11th.

ERIE, PA.—The Merchants' & Manufacturers' Electric Light Company has had favorable action taken on a communication submitted to the Select Council, asking that the Council advertise now for bids for lighting the city with gas and electric arc lights for the year beginning April 1, 1896.

BELLEVILLE, N. J.—The Kearney Electric Light & Power Company, which was organized this year for the purpose of supplying the township of Kearney with street lights, has made a contract with Belleville to light the streets of this place. The current will be carried across the river by a heavy cable.

SEATTLE, WASH.—A unique proposition has been made to the city by F. H. Osgood, A. L. Hawley and J. T. Robinson. They offer to build a complete arc lighting plant and operate the same for three years at a cost less than is now being paid for lights; at the end of three years the lamps and circuits to become the property of the city without further cost, the station and its apparatus remaining the property of the contractors.

THE ELECTRIC RAILWAY.

BLOOMFIELD, N. J.—A trolley line is proposed between Bloomfield and East Orange.

ALLENTOWN, PA.—There is a project afoot to build a trolley line from Allentown to Reading.

MONTREAL, CAN.—The Street Railway & Abattoir Company proposes to build a new street-car line.

CALDWELL, N. J.—The Borough Council has granted a franchise to the North Jersey Traction Company.

RICHMOND, VA.—The work of breaking ground for the line of the traction company has been commenced.

HAGERSTOWN, MD.—A line will be built from Hagerstown to Leitersburg, Cavetown, Md., and Waynesboro, Pa.

MILWAUKEE, WIS.—The McGann Street Railway has succeeded in obtaining a franchise from the Common Council.

SKANEATELES, N. Y.—The Auburn Interurban Railway Company has been granted a franchise through the village.

PITTSFORD, VT.—A movement is on foot for the building of an electric railway between Pittsford Depot and Pittsford Mills.

NEW HAVEN, CONN.—The New Haven Street Railway Company proposes to extend its Lake Whitney branch to Centreville.

EASTON, PA.—The authorities of Odenelдertown have granted permission to the Easton Transit Company to lay tracks on Adamson Street.

CAMDEN, N. J.—The Camden, Gloucester & Woodbury Railway Company has received permission from the city authorities to extend its lines.

TARRYTOWN, N. Y.—A. J. Mackey, of Tarrytown, has filed an application for the right to construct and maintain an electric railway in the village.

WORCESTER, MASS.—The City Council has granted a franchise to the Worcester Consolidated Street Railway Company to extend its tracks in the city.

PHILADELPHIA, PA.—The New Haven & Derby Electric Railway Company has a charter to build from New Haven to Derby, along the Derby Turnpike.

UNIONVILLE, PA.—The citizens of this place have subscribed about $20,000 toward an electric railway, which is to be built between Unionville and West Chester.

BANGOR, ME.—The electric railway company has received permission from the city authorities to lay a double track on Main Street, and will begin work immediately.

DENVER, COL.—The Western Electric Transit & Power Company will build and operate electric lines and furnish power in Arapahoe, Jefferson and Grant Counties.

WILMINGTON, DEL.—An electric railway between Wilmington and New Castle is again proposed, and vigorous efforts are being made to obtain the necessary subscriptions.

CHESTER, PA.—A survey is being made by Engineer Roberts of the route for the extension of the Prospect Street Railway through Folsom, Rutledge and Morton to the Baltimore Pike.

MADISON, WIS.—The city authorities have granted a franchise to H. C. Adams and W. T. Fish for the construction and operation of a street-car line the estimated cost of which is $20,000.

CROTON-ON-THE-HUDSON, N. Y.—The citizens of Croton will hold a meeting for the purpose of discussing the merits of the proposed electric railway, from Croton Station to Cornell Dam.

MANKATO, MINN.—C. L. Alleman and S. R. Snow propose to put in an electric railway if a franchise can be obtained. The plant will also furnish electric lights and exhaust steam for heating.

WOBURN, MASS.—The North Woburn Company contemplates the construction of a street railway from North Woburn to Wilmington, where connections will be made with the Reading & Lowell Road.

CLEVELAND, O.—Tom Johnson, of Cleveland, and other capitalists have organized a company with the intention of building a new street railway system in Buffalo. Six miles of track will be put down.

SPRINGFIELD, O.—The Dayton, Springfield & Urbana Railway Company has received from the County Commissioners its franchise to construct an electric railway over the National and Valley turnpikes.

FOND DU LAC, WIS.—Elihu Colman has closed a deal whereby the entire property of the Fond Du Lac Light, Power & Railway Company has been transferred to other parties, supposed to be Milwaukee capitalists.

LAUREL, MD.—A number of surveyors employed by the Maryland & Cumberland Electric Street Railway Company are in Laurel with the purpose, it is understood, of surveying a new route for the electric road.

NEW PHILADELPHIA, O.—The commissioners of Tuscarawas County awarded the franchise for the building of an electric railway between this city and Uhrichsville to Major Charles E. Mitchener, of New Philadelphia.

SOUTH HAVEN, MICH.—An electric road between Saugatuck and Benton Harbor is much desired by the business men and fruit growers of this locality, and right of way could be obtained for the asking by a *bona fide* concern meaning business.

CHICAGO, ILL.—The business men in the southern and northwestern sections of the city are anxious that the West Chicago Street Railway should extend its Ashland Avenue line to Twenty-third Street, and this will probably be done.

WEST CHESTER, PA.—The representatives of a party of New York and Philadelphia capitalists are interviewing the farmers between West Chester and Quakerville relative to securing the right of way between these points for an electric railway.

CAMBRIDGE, PA.—The electric railway between Cambridge and Edinboro, on which work is about to be commenced, will be extended to Meadville, via Venango and Saegertown. The line will be ten miles long, and the estimated cost is $12,000 per mile.

JEFFERSONVILLE, IND.—The Ohio Falls Street Railway of this city has been purchased by a Mr. Williams, representing a Southern syndicate, and the line will be immediately equipped with electricity and extended 25 miles to the Big Four Bridge at Louisville.

BOSTON, MASS.—It is reported that the New York, New Haven & Hartford Railway will at once commence the erection of repair shops and a large power house at South Braintree, to furnish electric power for the proposed line between that place and Boston.

PITTSBURG, PA.—It is stated that a rapid transit electric railway will be built between Pittsburg and New Castle, and that a number of New Castle, Pittsburg and Beaver County capitalists are interested in the movement and will shortly apply for a charter.

PHILADELPIA, PA.—The Pennsylvania Railway Company, which for some time has had under consideration the equipment of some of its smaller branches with electricity, will very likely introduce the trolley within the next few months on its Vincentown branch.

CHESTER, PA.—The route of the proposed extension of the Prospect Street Railway on the north side of the P. W. & B. Railway is being surveyed. The road will ultimately be extended through Morton and Rutledge to connect with the Delaware County & Philadelphia line.

TUNKHANNOCK, PA.—There is talk of an electric railway to connect Carbondale with Tunkhannock. The prime mover in the project is George M.

Shepherd, and the name of the road is to be the Tunkhannock & Carbondale Street Railway. An electric road is also contemplated between this place and Scranton.

HUNTINGDON, PA.—The Huntingdon Car & Wheel Works have been purchased by W. A. Obyon, of Savannah, Ga., for a syndicate of Southern capitalists, and the company will employ 500 men and manufacture trolley cars principally. A boiler works and malleable iron works will be connected with the new plant.

BELLEVILLE, N. J.—At a meeting of the Belleville Township Committee, Nov. 6, representatives of the Passaic & Newark Electric Railway Company, stated that they had recently received notice from the Consolidated Traction Company, to the effect that that company proposes to equip its line from Newark to Jerolemon Street, Belleville, with electricity.

AMBLER, PA.—Residents along the Chestnut Hill & Spring House Division of the Bethlehem Turnpike, in White Marsh Township, are being asked to give their consent for the construction of a trolley road. It is understood that if a franchise can be obtained on favorable terms the road will branch off from the Chestnut Hill & Norristown road and extend to Ambler.

Trade and Industrial Notes.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, reports the receipt of some flattering testimonials as to the Packard "Mogul" incandescent lamp, which appears to be rapidly growing in favor for lighting large interiors. A life of several thousand hours for these lamps is claimed to be quite an ordinary occurrence.

OSGOOD & BARKER, well-known manufacturers of paper mill machinery, of Bellows Falls, Vt., have taken up the manufacture of dynamos and motors, and will give special attention to the building of motors for boats and carriages, as well as general repair work. Among the orders which they now have on hand is one for a 2-hp motor to be used in a launch now run by steam, and one for a 200-light dynamo for a neighboring manufacturer.

JOHN WEDDERBURN & CO., patent attorneys, of 618 F Street, N. W., Washington, D. C., last week awarded a $150 prize to D. F. Cornell, of Westfield, Pa., for an improvement in lathe carriages. This is one of the regular series of prizes which this enterprising firm awards each month for the best and simplest invention brought to their attention during the preceding month. This unique policy is winning the firm many friends among inventors.

A TASTEFUL CATALOGUE has been issued by W. D. Forbes & Co., 1300 Hudson Street, Hoboken, N. J. This enterprising firm is now building a very compact type of high-speed automatic engine for electric light service, made in sizes ranging from 40 to 100 hp, according to steam pressure and size of cylinder. The firm also manufactures a serviceable milling machine and a line of lathe chucks which are made in universal, independent and combination form. The chucks are known as the "National" and are sold only through Wm. Whitlock, 39 Cortlandt Street, New York.

A NEW CONSULTING FIRM.—Appreciating the fact that capitalists and business men generally are beginning to realize the importance of a competent consulting engineer in construction and kindred work, Messrs. A. D. Scott and D. J. Pearson, of St. Louis, Mo., have formed a partnership, under the style of the A. D. Scott Electric Company, with offices at 405 Security Building, for the purpose of preparing plans and specifications for all kinds of electrical and mechanical work, designing special machinery and apparatus, and acting as supervisory experts. Both members of the firm have had a diversified and valuable individual experience along the lines of work which they have now undertaken jointly.

STILL OVERWHELMED with business, the Ferracute Machine Company, Bridgeton, N. J., is neverthless keeping its orders very nearly up to date by means of extra help and overtime work. The company is now building a number of indexing presses for cutting the slots in toothed armature discs; one of these is for the Crocker-Wheeler Company, and the others go to various western factories. The Ferracute Company recently built a pair of extra large presses for the Crocker-Wheeler Company, which were fitted with direct-connected electric motors and controllers, in accordance with the whole factory equipment of the latter concern, and an order has just been received from the General Electric Company for two large presses to go to Germany.

THE AMERICAN DISTRICT STEAM COMPANY, of Lockport, N. Y., has issued a comprehensive catalogue, describing the Holly system of direct and exhaust steam heating, which contains some strong arguments in the support of the practice, daily growing in favor with electric light and power plants, of furnishing heat to neighboring buildings by means of their exhaust steam. The Holly system has been worked out very carefully in every detail and contains many special features, the design of which gives evidence of high engineering ability. One of the most ingenious devices used in connection with the Holly system is a "service variator," which takes the place of the well-known but less efficient expansion joint, and provides for the expansion and contraction of the underground piping. There are also steam traps, cooling coils, pressure regulators, steam meters, etc., especially designed for use in connection with this system.

THE NEWBURGH ICE MACHINE & ENGINE COMPANY, of Newburgh, N. Y., has purchased the plant and business of the Whitehill Engine & Pictet Ice Machine Company, and will continue the manufacture of the Whitehill-Corliss engine, for electric light and other service, which the latter company has been building. Mr. Robert Whitehill, the designer of the engine, is the secretary of the new company and is a man of long and varied experience in engine design and manufacture, having been for some time associated with the E. P. Ellis Company and more recently in charge of the engineering department of the company just bought out. Mr. Edgar Penny is the president of the new company and is also an old engine builder, having been superintendent and designer for George H. Corliss, at Providence, R. I., and, for the past twelve years, mechanical engineer and managing director for the Frick Company, of Waynesboro, Pa. It is not difficult to predict the grade of work which will be turned out by the new company under two such able men as Messrs. Penny and Whitehill, and it is safe to assume that the company's efforts to produce the very best class of engines will be duly appreciated by the trade at large.

A TRIAD OF CATALOGUES has been published by the Siemens & Halske Electric Company of America, which will be of much interest to the trade. The subjects are "Electric Motors," "Band Arc Lamps," and "Electric Rock Drills," and the books give intelligently written and judiciously illustrated descriptions of the apparatus named. The catalogue devoted to electric motors describes direct-connected and geared motors, rigidly mounted, flexibly suspended motors, and the Siemens electromagnetic safety coupling, and calls particular attention to the many advantages obtainable by the use of electric motors in factories and mills, for which service the company builds a large number of machines, each specially adapted to the work it is to perform. The engravings show the special motors and the manner of mounting them upon their respective machine tools. The arc lamp catalogue describes the "band-feed" lamp made by the Siemens & Halske Co., which is a very simple, compact and substantial piece of apparatus. The upper carbon-holder or carriage is suspended by a copper strip or band, which gives the lamp its name. This band passes over a drum which is actuated by a shunt magnet to strike the arc and feed the carbon down. These lamps are made to burn 18 hours with one trimming, and are exceedingly handsome in appearance. A summary is given of the advantages embodied in the use of constant potential arc lamps which will appeal very strongly to central station managers. The rock drill catalogue discusses rotary and percussion drills driven by an electric motor which is enclosed in a protecting case, connection between the motor and drill being effected by means of a flexible shaft. The three catalogues contain much valuable information, aside from the description proper of the apparatus manufactured by the company.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 5, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

549,094. BRAKE FOR ELECTRIC OR OTHER CARS; Edward S. Amrock, of Waltham, Mass., assignor of one half to James H. Walsh, of Boston. App. filed March 16, 1892. In combination with a car propelled by an electric motor, a hydrostatic bellows having heads of different areas, the larger head being connected to the brake beam and the smaller one to a lever which actuates the motor controller, the one lever thus operating both the controller and brake.

549,132. ELECTRIC ARC LAMP; F. Jehl, Vienna, Austria-Hungary. App. filed May 12, 1894. The combination of a carbon electrode, a quiescent or stagnant gaseous envelope surrounding and extending along the said carbon to the point or face from which the arc emanates.

549,136. STREET-CAR LIGHTING; F. E. Kinsman, Plainfield, N. J. App. filed Feb. 27, 1895. The combination of a branch from the main line exterior to the car containing lamps in series, another branch containing a storage battery and a resistance, supplemental lamps in an open circuit from the battery and means for operating these lamps.

549,153. CONTROLLING ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 8, 1895. A system which consists in connecting two motors between an outside main and the neutral, and then connecting them between the two outsider mains, preserving the connection to the neutral between the two motors.

549,162. ELECTRIC SWITCH; J. B. Smith and A. L. Clough, Manchester, N. H. App. filed April 26, 1895. The combination of a switch having springs tending to hold it in an open position and electromagnets tending to hold it in opposition to the springs when current is sent through them.

549,179. PRINTING TELEGRAPH SYSTEM; J. E. Woodbridge, Duluth, Mich. App. filed Jan. 29, 1895. The combination of a shaft and means for rotating it, a series of interlocking stops each having three functional positions, and electromagnetic mechanism to control the stops.

549,189. SYSTEM OF ELECTRICAL DISTRIBUTION; W. M. Fairfax, Brooklyn, N. Y. App. filed Feb. 7, 1893. A method consisting in supplying current to a number of groups of translating devices in succession and maintaining the potential constant in each group by generating a counter E. M. F. by the varying current in the respective group.

549,195. ELECTRIC METER; R. O. Hood, Danvers, Mass. App. filed March 9, 1895. The combination of an electric motor placed in circuit to be measured, means for stopping the revolution of the motor at regular intervals of time, and a device for recording the revolutions of the motor.

549,205. TOWER STRIKE; T. R. Mercein and E. R. Porter, Milwaukee, Wis. App. filed March 23, 1895. The combination of a passageway having a sounding device interposed at an intermediate point within, and a series of detached striking devices arranged to travel through the said passage and make contact during such travel with the sounding device.

549,209. ELECTROMAGNETIC SWITCH; C. D. Penny, Newark, N. J. App. filed March 12, 1895. The combination of a electromagnet having two coils, one stronger than the other, the lesser coil being included in the main circuit, a governing circuit including the other coil, the armature controlling the main circuit.

549,234. ARMATURE FOR DYNAMOELECTRIC MACHINES OR MOTORS; W. Decker, Owego, N. Y. App. filed Nov. 17, 1892. An armature consisting of an electric machine whose poles are four in number, or divisible by four, an armature winding of two groups of coils, one differing only in length, the said coils being connected in sets.

549,237. ELECTRIC SWITCH; G. W. Hart, Hartford, Conn. App. filed March 19, 1895. A switch supporting the handle from the base, a spring-depressed collar between the handle and cover, and the said collar thrusting the cover toward the base with a yielding pressure.

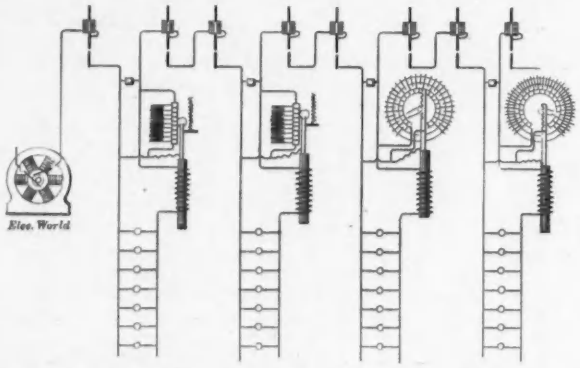
549,240. Filed Dec. 11, 1893. 549,241. Filed Feb. 3, 1894. ELECTRICAL ANNUNCIATOR; R. L. Hunter, Minneapolis, Minn. The combination of one or more call indicators, all operative jointly by any one of several circuit closers, and adapted to give a combined indication and return calls in circuit partly in common severally with the indicator circuits, and operative only when the indicator circuits are broken.

549,254. METHOD OF MAKING INSULATOR RINGS; C. F. Peterson, Schenectady, N. Y. App. filed June 1, 1895. A method consisting in forming flanged rings of built up pieces of mica by bending them and then assembling them to form a shape, cementing them together as the irregular structure is built up, and finally subjecting it to pressure and heat.

549,268. ARC CUT-OUT; C. D. Haskins, Newton, Mass. App. filed March 6, 1895. The combination of house and main-line terminals, conducting springs connecting the main terminals, contact members carried by the springs, and means for operating the levers.

549,342. METHOD OF LINING TUBES AND CYLINDERS; J. H. R. Ward, Stoughton, Mass., and C. A. Noll, New York, N. Y. App. filed Aug. 15, 1895. A method of lining tubes or cylinders consisting in completely filling the tube or cylinder with a liquid holding solid matter in suspension, and then rotating the tube.

549,346. TRANSMITTING TIME SIGNALS; C. E. Buell, North Plainfield, N. J. App. filed May 27, 1895. The combination of a series of circuits centring at a switchboard, apparatus for outgoing signals, automatic mechanism for connecting the several circuits for a brief interval, a generator of electricity having connection to the joined circuits through mechanism that is controlled by a standard clock, secondary clocks on the circuits adapted to be set to a standard time by the transmitted signals, and an annunciator in each circuit that is located in a neutral portion of the system during the transmission of the outgoing time signals.



No. 549,189.—System of Electrical Distribution.

549,383. AUTOMATIC REGULATOR FOR CONVERTERS OF ENERGY; W. E. Moore, Augusta, Ga. App. filed March 20, 1895. The combination of a motor and an adjustable power cut-off connected thereto, a speed indicator operated by the motor, a source of electricity, a plurality of electrical circuits controlled by the speed indicator, and mechanism operated by the electric circuits for moving the cut-off in either direction to a point proportional to the number of said circuits energized by the speed indicator.

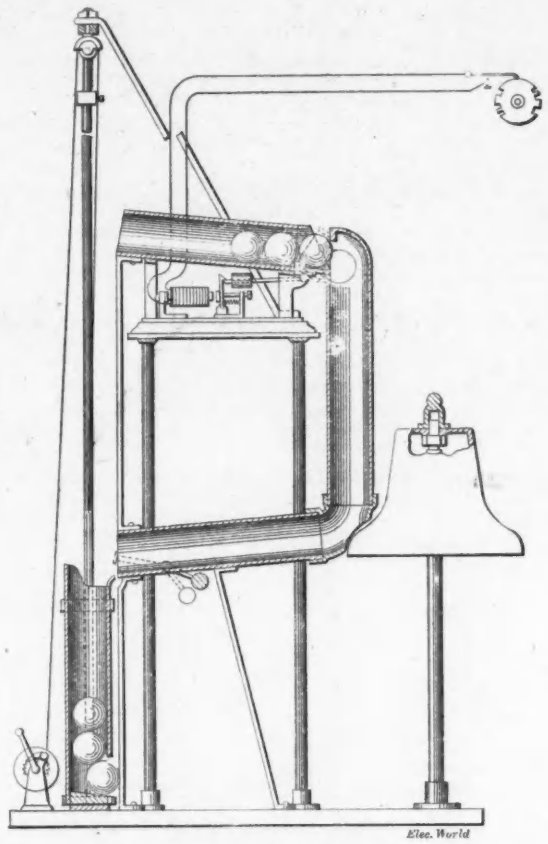
549,409. ELECTRIC ARC LAMP; C. P. Vogelius, Bloomfield, N. J. App. filed Jan. 17, 1895. The combination of the shell of an enclosing chamber and its lower flange, a globe and a globe-holding ring, bolts detachably connecting the ring and flange, and the globe suspending a yoke connected to the globe at the bottom, and made slidable therein to a limited extent.

549,416. INSULATING RAILS; F. W. Wilson, New York, N. Y. App. filed June 22, 1895. The combination of an insulating base plate having openings at opposite sides, the clips extending over the base flange, and also having an integral portion extending downward into the openings in the base plate, and insulating side pieces interposed between the clips and the upper surface of the rail base, and fastening devices for the clips.

549,443. ELECTRIC SUPPORTING INSULATOR; J. Collins, Washington, D. C. App. filed Sept. 23, 1895. An insulator, the outer surface of which is composed of rectangular planes having at a predetermined point of its length a groove extending inwardly from each side of the outer rectangular surface.

549,449. APPARATUS FOR INDICATING DIFFERENCE OF PHASE; M. Von Dolivo-Dobrowolsky, Berlin, Ger. App. filed April 20, 1895. The combination of an alternating current generating machine, mains leading from the same having translating devices connected thereto, and also a shunt circuit witha fine wire coil or set of coils placed therein, and a thick wire or set of coils located in the main circuit and a metallic body rotatably arranged in the magnetic fields connected with a device for opposing a counterforce to the rotation of the said metallic body and means for indicating the amplitude of the latter.

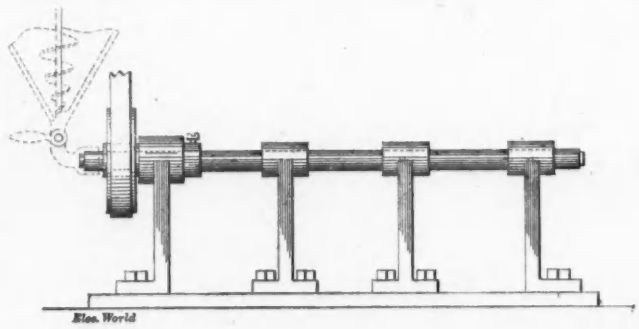
549,456. CARBON CONTACT RESISTANCE SWITCH; F. G. H. Meyer; Charlottenburg, Ger. App. filed April 4, 1894. The combination of a vertical rocking lever carrying two horizontal arms engaging with a slide movable refractory contacts carried upon the slide, and stationary refractory contacts adapted to be successively engaged by the movable contacts.



No. 549,205.—Tower Strike.

549,464. ELECTRICAL DENTAL ENGINE; F. C. Priestly, Denver, Col App. filed Feb. 12, 1895. The combination of a motor, a plunger, a spring for imparting motion to a bar in one direction, a solenoid for imparting motion to the bar in the opposite direction and lying in the motor circuit and means for alternately making and breaking the solenoid circuit at the motor as the armature rotates.

549,470. ELECTRICAL RESISTANCE; H. E. Werline, Lancaster, Pa. App filed Dec. 23, 1895. The combination of a non-conducting core, a series of conductor filaments coiled concentrically one over the other, and electrical connection between such filaments, the resistance one of filament varying in a direction opposite to that of the other filaments under changes of temperature.



No. 549,342.—Method of Lining Tubes.

549,477. LOCAL TRANSMITTER CIRCUIT FOR TELEPHONES; W. W. Dean, St. Louis, Mo. App. filed March 29, 1895. The combination of a local transmitter circuit having two branches, an induction coil having its primaries in each, and their secondaries in the telephone line, a microphone also in each of the branches and means for simultaneously increasing the resistance through one of the microphones as the other is decreased, and a source of current adapted to direct current through said branches in parallel.